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Agricultural Impressions of Java.

BY

Dr. Leslie C. Coleman, M.A., Ph.D.,

Director of Agriculture in Mysore.

The one thing that impresses me most strongly in a study of agriculture in Java is the very great amount of money and work that is being expended upon experiments for the improvement of crops. The country has been singularly blessed by nature as regards both soil and climate. The soil is on the average very much richer than that of Mysore, while the climate in most of the island exhibits such plentiful and good distribution of rainfall that crops apparently rarely fail. There are exceptions, however, and the present year has seen quite severe conditions of drought in the eastern portion of the island.

One might have supposed that under these favourable conditions it would not be considered necessary to devote much energy towards improvement. This is, however, very far from the case. The Government Department of Agriculture has an expensive organization for experimental work and this is very largely supplemented by experiment stations for many important crops which are supported

by private enterprise. These private organizations spend altogether the equivalent of about Rs. 30 lakhs a year upon the maintenance of experiment stations for rubber, tea, coffee, coconuts, cinchona and sugarcane. The private agricultural organizations in Java, therefore, spend more on agricultural improvement than the Government of Madras on its whole agricultural operations. They spend nearly three times as much as is spent on agriculture in Mysore. As far as I am aware, there is no doubt in the minds of the agriculturists who put up this large amount of money each year that they are getting a very good return for their investment. So sure are they of this that they are now beginning to restrict the supply of information which is obtained from their experimental work to the people who put up the money for this work.

What are the results ? One result has been the production of a new variety of sugarcane which has increased the yield per acre of sugar by between 20 and 30 per cent. This cane, within five years, has replaced almost entirely all other varieties previously grown on the sugarcane fields of Java. It is estimated that during the present year 98 per cent of all the sugarcane in Java belongs to this one variety, a variety which ten years ago did not exist.

What has been done for sugarcane is being done perhaps to a lesser but still to a very appreciable degree for coffee, tea, rubber and coconuts. All of these crops are, through the introduction of new varieties and better systems of cultivation and manuring, showing steady increases in production.

What is the lesson to us ? Our natural conditions are undoubtedly not so favourable as those generally existing in Java. If, then, we are not to remain in a hopelessly backward condition or if we are to see our economic condition improve rather than deteriorate, it must be by more intensive efforts towards agricultural betterment. A greater insistence on accurate experimental work on all lines both by the Agricultural Department and private individuals seems necessary if Mysore is to gain and keep its proper place as an enlightened and prosperous people.

Ground Grubs and Their Movements in Soils.

BY

Dr. K. Kunhi Kannan, M.A., Ph.D.,

Entomologist to the Government of Mysore.

While studying a few years ago the habits of the grubs of the Palm Beetle (*Oryctes rhinoceros*) I noticed that they were to be found for the most part along the outer edge of dung heaps where dung is dried and broken up. This preference was due, it was thought, to greater æration in those places compared to the interior of the heaps where the dung is more compact. Three years ago when studying the habits of cockchafer grubs attacking the roots of cane it occurred to the writer that possibly the roots were cut because they were in the way and not because they were sought as food. There was the more reason for thinking so because several of these had been reared from egg to adult in soil rich in manure but with no green vegetable matter at all. It was believed that grubs congregated round the roots of cane for the reason that at the time of attack there was better æration round the roots. To test the correctness of this conclusion a good number of grubs were equally divided and put into two jars containing soil of the same kind and texture upto two-thirds of the height. On top of the soil in each, a layer of fine sand two inches thick was placed. The sand layer in one was soaked with water and the other kept dry. Next morning the grubs in the jar with moist sand were near the sand layer, but in the other jar where the sand was dry the grubs remained near the bottom. It was clear that the water soaked sand had cut off the supply of air in one case which compelled the grubs to come towards the top while in the other, there having been no such interruption, the grubs were not inconvenienced. A third species of grubs attacking betelvine (a species of *Holotricha*) was reported in the cold weather of 1930, the grubs being found cutting off suckers and roots. The grubs were small, not more than an inch long. It preferred to be round the roots of which pieces were definitely found in the alimentary canal. The roots showed distinct marks of injury. In this particular case, among several of the experiments tried, a plot was plastered with mud and another had the soil loosened in it. In

the first case the grubs had worked their way very near the surface and in the other they remained at their usual depths.

From these observations and experiments it is concluded that respiratory requirements have not a little to do with the movements of the larvæ in the soil and if these are properly met they will not leave their usual depth and may keep clear of the roots. It often happens in sugarcane fields that the soil gets compacted and packed by various agencies as rain, movements of labourers, etc. When this happens there is deficiency of air supply to the grubs which therefore wander to places where they have more of it, about the root system where there is more manure and better tillage, and the air supply is greater. There is the additional attraction of the organic manure round them. It is believed that uniform manuring of the field and thorough cultivation where root grubs are becoming serious may divert them from roots of the crops to food more natural to them, *viz.*, the soil rich in organic matter.

Ground grubs are difficult to get at. Fumigation with poisonous gases is difficult and costly for Indian ryots and means have to be found which is within their reach. If the measures suggested above should prove satisfactory, they would be welcomed heartily.

The members of the Union who are troubled with the ground grubs are requested to test this method and report on it to the Entomologist to the Government of Mysore.

Sexuality of the Koleroga Fungus.

Phytophthora arecae (Colm) Pethyb.

BY

M. J. Narasimhan, B.A.,

Officiating Mycologist, Department of Agriculture, Bangalore.

Plants can be propagated either by cuttings or by seeds. While in the case of cuttings, the resulting plants develop true to the type of the mother plant, it is not always so in the case of seeds. It is possible to grow the same kind of sugarcane from cuttings but plants grown from seeds formed in sugarcane arrows show a good deal of variation. This is because the development of the seed is the result of the sexual fusion of different characters.

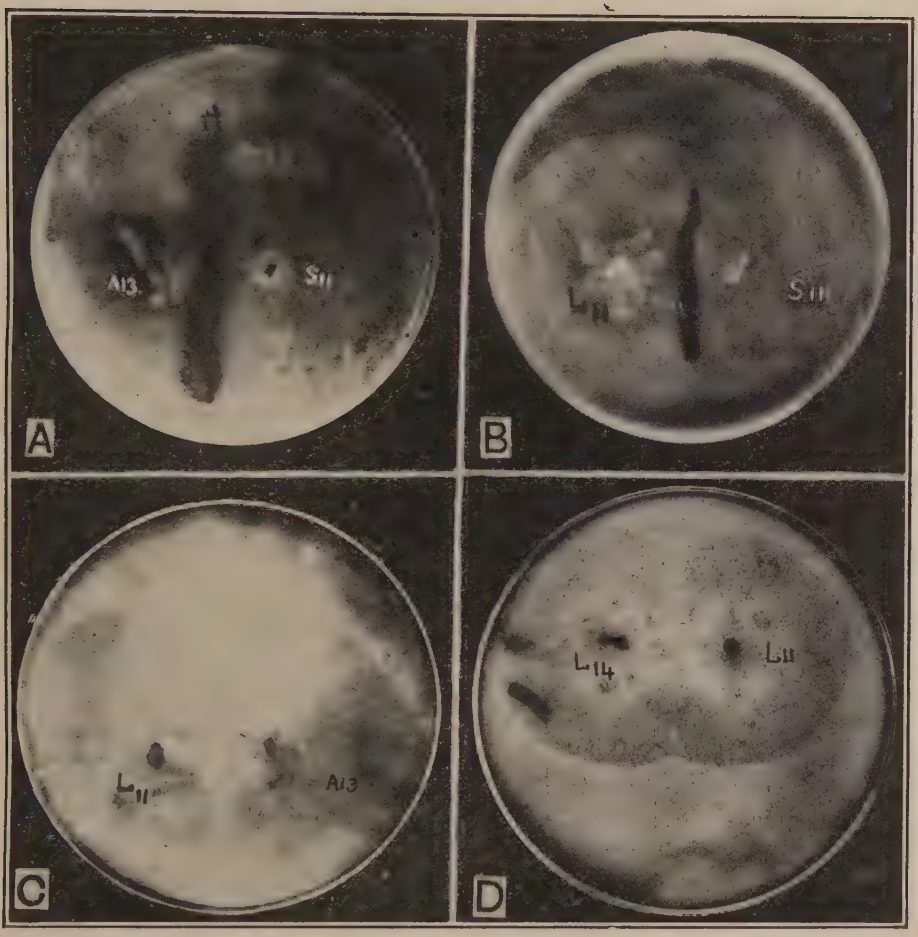

Fig. 1.

A.—Paired Cultures of Areca (A) and Sandal (S) Kolerogas : dark line shows area where resting bodies are formed. B—Loranthus (L) and Sandal (S) Kolerogas : dark line present. C—Areca (A) and Loranthus (L) Kolerogas : no formation of dark line. D—Two Loranthus Strains : no formation of dark line.

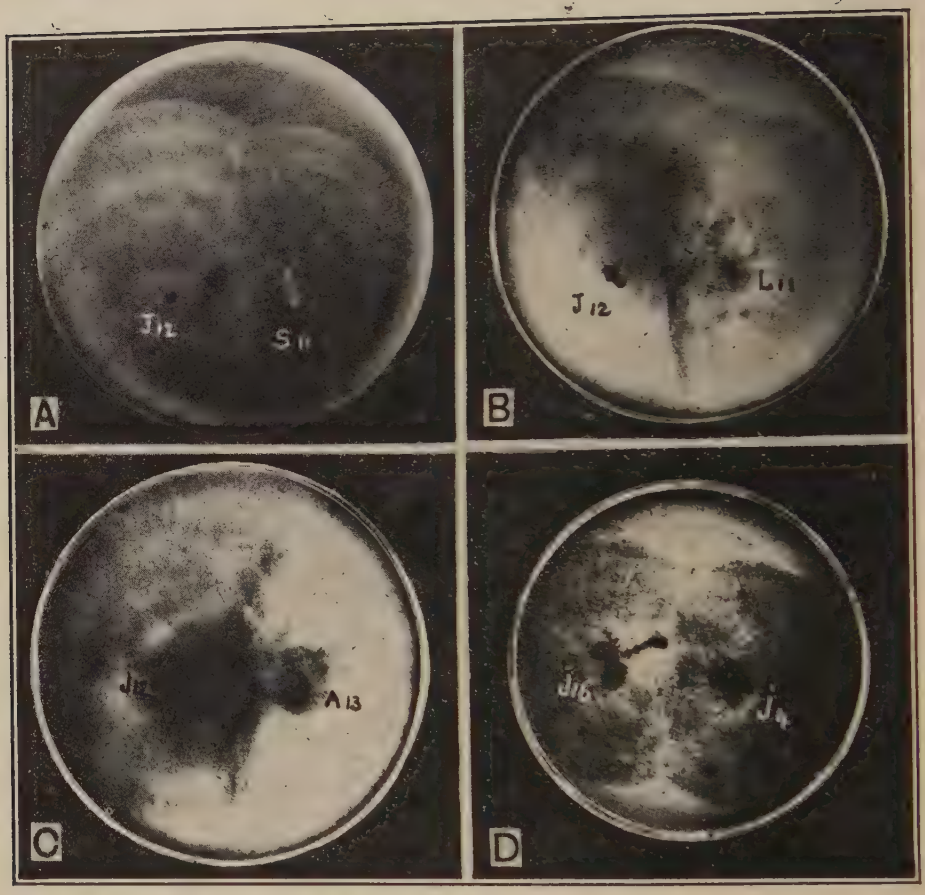

Fig. 2.

A.—Paired Cultures of Jatropha (J) and Sandal (S) Kolerogas : no formation of dark line. B—Jatropha (J) and Loranthus (L) Kolerogas : dark line formed. C—Jatropha (J) and Areca (A) Kolerogas : dark line formed. D—Two Jatropha Strains : no dark line.

The idea of sex in plants is well recognized when one speaks of the male and the female papaya plant. But it is not generally known that every plant has, enclosed in its flowers, special parts which are differentiated into male and female elements. These two parts may be found in one flower, or in different flowers of the same plant or sometimes separated on two different plants of the same kind. When the male element is carried by means of wind or insects, on to the female element, an elaborate process of fusion takes place, which results in the development of the fruit and the seed.

This process of fusion and the setting of the seed can be recognized with the aid of a microscope throughout the vegetable kingdom. Even in the case of the ordinary green pond scum, two small swimming bodies not distinguishable one from the other, fuse together, develop a thick wall and come to rest. The vicissitudes of nature do not affect these resting bodies. The pond may dry up, and the silt get caked by the sun's heat, yet the viability of these resting bodies is not lost, as the scum is in evidence with the next rain.

A similar process can be said to take place in the arecanut koleroga fungus, which has much in common with the pond scum, except for the difference that it is not green. Though it does not actually live in water like the pond scum, it thrives under moist conditions on plants. With the setting in of the S.-W. monsoon, the development of the fungus is considerably favoured, and the disease spreads from tree to tree with great rapidity. Millions of tiny swimming bodies are formed on the affected nuts and are carried from tree to tree borne on the stormy winds and perhaps by the innumerable insects flying about. The tiny swimming bodies and the fine threads which cause havoc during the rains are not able to withstand drought and die. How, then, does the disease appear during the next monsoon after a period of five months' severe drought? This has long been a difficult problem.

In other countries, where koleroga is known to occur on apples, beans, castor, etc., this problem of the seasonal appearance of the disease can be explained easily. The fungus affecting these crops develops thick-walled resting bodies (Fig. 3, B. and C.), by which the hot season is tided over and which spread the disease during

next season. But no such bodies have been found in the case of the areca koleroga, which makes the problem difficult.

Before attempting to offer a solution of this problem let us see how the resting spores are formed. Initially, two knob-like projections are put forth by the fungus one being the male and the other the female element. The latter grows through the male, fusion of the contents taking place during the process, and develops into round body, which later becomes thick-walled (Fig. 3 A.). The crown-like appendage on the thick-walled body in Fig. 3 B. is the remnant of the male still adhering.

As said before, no such resting bodies have been found in the areca koleroga. An investigation of this problem has thrown light on how the areca koleroga fungus is likely to perpetuate itself from season to season. Looking around the affected areas of arecanut one finds that a number of other plants growing wild in the area are affected by a similar disease, notably sandal. The disease manifests itself in sandal by causing the entire fall of the leaves and the rotting of tender shoots and fruits. Loranthus (Bandarike) is affected similarly. In the case of *Jatropha curcas* (Kadakalli), the fruits are affected. In none of these diseases do resting bodies develop. In cultures of the sandal and areca koleroga conducted for long periods, the resting bodies have never been found. On the other hand when these two kolerogas are grown together in mixed cultures numerous resting bodies develop within a week's time. Fig. 1—A. and B. shows the two fungi grown together. Where the two meet, a brown line (black in the photograph) is formed indicating the area where the resting bodies are formed abundantly. A careful examination of the area where the two meet brings out the interesting fact that the areca koleroga forms the male element, and the sandal koleroga the female element, the resting body being the result of the fusion of the two. Of the four plants affected by koleroga, *viz.*, Areca, Loranthus (Bandarike), Sandal and Jatropha (Kadakalli), the fungus on any of the first two grown with that on any of the other two, produces resting bodies. No such bodies develop when the first are grown together (Fig. 2 C.) or the two latter (Fig. 2 A). The significance of this find is yet to be fully tested in the field. But it would seem to be not too violent a stretch of the imagination to picture a similar

Fig. 3.

A—Showing how a resting body is formed. Fungus threads of Areca (A) and of Sandal (S) are seen fused together.

B—Thick-walled resting spore formed by the Areca-Sandal combination. The crown-like structure at the top is the remnant of the male element.

C—Resting spore formed by Areca-Jatropha combination.

occurrence on natural hosts in the field. The close proximity of plants like sandal, etc., to areca gardens, allows for the transfer of the minute swimming bodies of one disease on to the other. This leads to a development of both the strains on one host and results in the production of resting bodies, which can withstand drought. Stretching this point a little further, one can imagine that with the outburst of the next monsoon, the resting bodies germinate, and segregate into two strains, one of them affecting arecanut, and the other affecting sandal. But this is a subject which is being investigated at present.

The interesting question arises out of this investigation whether we can stamp out the areca koleroga disease, by combating the complementary kolerogas found round about the garden. Even after twenty years of spraying, areca koleroga has not been stamped out in individual gardens, though its virulence is mitigated considerably. The sandal koleroga is the one which approximates nearest to this. The practicability of spraying sandal round about the garden in order to prevent the formation of the resting bodies is being considered at present.

The Propagation of the Pepper Plant.

BY

A. K. Yegnanarayana Iyer, M.A., Dip. in Agri. (Cantab.), N.D.D.,

Deputy Director of Agriculture in Mysore.

The propagation of the pepper plant in the Shimoga *malnad* as it is carried out at the present time is capable of improvement in important respects. The improvements relate to two main points : *viz.* (1) the selection of the parent plants, and (2) the actual method of propagation from the selected plant or plants.

The selection of the parent plant to propagate from is obviously of such great importance that it hardly needs to be emphasized. In the case of the pepper this assumes much greater importance than in the case of the ordinary agricultural crops ; the reason is the fact that pepper takes about four years to come into full bearing : it is therefore not until four years after planting that one can discover the quality of the plant raised by him and it takes another four years for

him to rectify any mistakes. In this respect it resembles the other perennial plantation crops areca-nut, cocoanut, and to some extent coffee ; but whereas in the case of these latter crops, even very careful selection of the parent plant may not be followed by the desired result, in the case of the pepper, such selection is assured of the expected result, the reason being, of course, that the former are all propagated from seed, whereas pepper is propagated vegetatively from cuttings. This therefore is an additional reason why such selection in the case of pepper is doubly important.

The quality for which selection is made is a high yield of crop. If every vine in a garden is systematically numbered and its yield from year to year correctly recorded, we can, of course, on the strength of this record of performance during a number of years select the good yielders and use them as parents to propagate from. Though this kind of performance record is necessary in the case of the pepper quite as much as for the other crops like coffee, cocoanut or areca-nut, still there are circumstances differentiating the pepper plant in this respect also which make such selection for high yield a much easier task. The reason is this :—the pepper plant is peculiar in the kind of the flowers it carries. It is a diœcious plant, that is to say, the male flowers and female flowers are borne on different plants, some plants have only staminate flowers and some have only pistillate flowers, and curiously still, other plants have flowers which are hermaphrodite, *i.e.*, carry both pistils and stamens in the same flower. Obviously from a crop-bearing point of view, only the last two, *i.e.*, female and the hermaphrodite, plants are of value, barring of course the need for a few male plants to yield the required pollen where there are no hermaphrodite plants. And even of the two, the hermaphrodite plant is a more desirable one, because in such plants every flower is fertilized and sets fruit. In the female plants, there cannot be this uniform setting of fruit ; fertilization is very irregular, some flowers set fruit, others do not and still others at irregular intervals. The result is that whereas in the hermaphrodite plants, the clusters are well filled and the berries uniform, in the female plants the clusters are not always so but often have blank spaces in their length while the berries are also varying in both size and degree of ripeness. Other things being equal, it is therefore the hermaphrodite

flowered plants which will be the best bearers and should consequently be the plants one would like to have in his garden to the exclusion of the other two ; because every vine in such a garden will be a bearing vine, and if propagation should have been made in addition on the basis of a record of performance, every vine will be not only a bearing vine but a good bearing vine also.

The selection of a parent vine therefore becomes exceedingly easy because we can for one thing exclude the male vines almost entirely. Of the female plants, we cannot be so sweeping, because under favourable conditions they may be desirable ones. In practice, however, the hermaphrodite plants are much safer and apart from theoretical considerations they also happen to have been the best producers among the different kinds of the vine tested on the Marthur Experimental Farm.* On this Farm a performance record of all the pepper vines has been kept from the year 1924 and as the result of this record six plants have been selected as parent plants to propagate from. It happens that all these six plants are hermaphrodite plants though the record related to a large number of female plants as well. The ordinary garden owner wishing to get cuttings for planting, has therefore merely to select the hermaphrodite plants and take cuttings from them. What however is actually done by garden owners as far as I have seen, is that about the end of June cuttings are taken from any vine in the garden which may have grown well and afford plenty of the lower branches to cut from, irrespective of whether it may be a male, female or hermaphrodite. This kind of indiscriminate choice of parent vines naturally leads to the garden becoming stocked full of vines of all kinds, luck or chance alone deciding whether the majority of them are plants worth keeping at all. If anything the choice is likely to be all in favour of the poor kinds, unless one is careful, because the male vines in flower are very showy and attract attention as desirable plants. They are covered with thin long numerous cream coloured spikes, all hanging like little strings of seed pearls, and showing off like a decoration. These have been shown to me by many a garden owner as the best plants.

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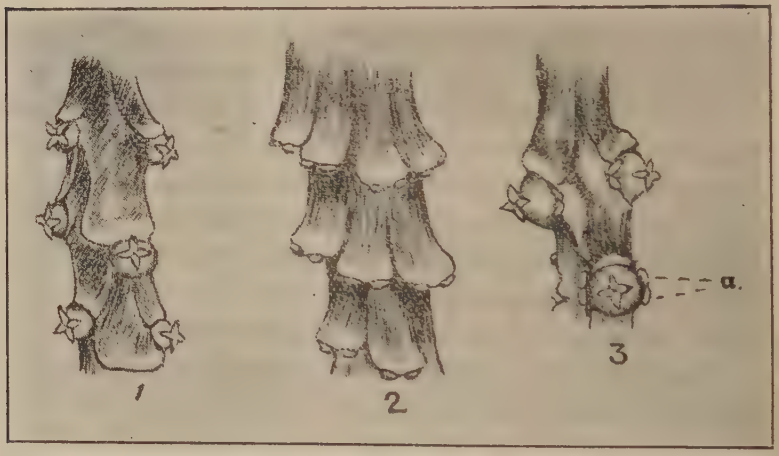
* The Selection work on the Marthur Farm is being done with the primary object of providing cuttings of high-yielding strains to private growers.—*Ed*

It is very essential therefore that garden owners should be able to identify these three different kinds of plants in their gardens so that they can propagate only from the hermaphrodite plants and gradually in the course of a few years have their garden filled entirely with such plants. At present none of the men whom I have come across, not even those who know a great deal about pepper cultivation appeared to know these features of the pepper plant. One garden owner indeed pathetically appealed to me to do something to prevent the shedding of the spikes of his best plants (*i.e.*, male, every one of which sheds and leaves the bush bare) in the belief that these did not fruit because some disease caused them to shed before they could set fruit !— an observation which strikes one as unaccountable amongst these garden owners who are all men of great practical experience. And yet it is one of the easiest things to identify these three kinds of flowers. The three different flower spikes are illustrated below.



Portions of the three kinds of pepper spikes referred to in the text, drawn highly enlarged. 1. Female. 2. Male. 3. Hermaphrodite ; the presence of the stamens (*a*) distinguishes this from the female spikes (1).

The flowers open about the same time of the year as the cuttings are usually taken, *i.e.*, the end of June (many flowers open much earlier also) and in this stage the male can be easily seen and identified with the bare eyes. The other two may require a small hand lens with the help of which and the drawings given here, it will be very easy to identify the two. At a later stage,

however, that is to say, when the berries are beginning to swell, the hermaphrodite will be easy to distinguish from the female on account of the presence in the former of the two little black dots one on each side of the base of the berry, which are the dried remains or scars of the stamens ; these, of course, cannot be seen in the female spikes. If all such plants are marked in one year at this stage, in the next year they can be propagated from, even though for want of a hand lens it may not be possible to identify its spike at that time. With the method of selecting suitable parent vines so easy, it is a pity that garden owners have been propagating vines indiscriminately, with the result that gardens are full of all sorts of useless bushes which with a little knowledge they could easily have avoided. In the case of a plant like pepper which comes into bearing only after some five years and continues to bear over a long period of some twenty-five years, the wastefulness and loss involved is really suicidal.

The selection of parent plants for propagation does not of course end with the identification and use of hermaphrodite plants alone, as described above. Among the hermaphrodite varieties themselves there are characteristics of varying degrees of excellence such as length of spikes, size of berries, liability to shed fruits or whole spikes if picking should be slightly delayed, early or late maturity, liability to disease and so on. The selection of hermaphrodite plants therefore merely narrows down the number of plants from which to select. The following table shows the sex of the varieties that are being grown in the Shimoga *malnad* including those introduced in the Marthur Farm.

TABLE.

Name of varieties.	Male, Female or Hermaphrodite.
1. Tattisara ..	Hermaphrodite.
2. Malabar No. 1 ..	do.
3. Do. No. 2 ..	Female.
4. Kalluvalli ..	Hermaphrodite.
5. Balamkota ..	Hermaphrodite.
6. Malligesara ..	Female.
7. Vakkal-muruta ..	Female.
8. Doddaga ..	Female.
9. Kadamensu ..	Female.
10. Karimaruta ..	Female.

On the Marthur Farm the varieties Kalluvalli and Balamkota, both Malabar varieties and both hermaphrodites, have been found the best yielders and six of them have been selected as mother plants, as already stated and all the new plantings on the Farm and replacements are partly from these plants and partly vines of the same variety got from Malabar. Individual records, testings of different varieties, etc., are being conducted with the object of further improvement.

Such exclusive plantings of only these varieties may not be possible for private garden owners, although a large number of such cuttings are being got out every year for the last three years for supplying to garden owners. Large as this number is, it is hardly more than a drop in the ocean when the requirements are considered, and even if the number imported should be doubled or quadrupled it will remain far short of requirements. Garden owners will therefore have to get their planting material, as they do at present, from their own gardens or gardens near about. In such circumstances, they cannot do better than make use of the information given above, identify and note down the hermaphrodite plants in such gardens and take cuttings only from such plants. They will be then stocking their gardens entirely with good bearing plants, and even though such plants may not all be equal to the Kalluvalli and Balamkota varieties, still the result will be a great improvement on the present local methods, which certainly are not calculated to ensure planting material of good quality even to a moderate extent.

II

Having selected the parent vine, the next point is the actual method of propagating. It may be remarked that even here there is room for improvement. At present the only method followed consists in obtaining cuttings some three to four feet long and planting them at the rate of from three to as many as seven cuttings to each standard. The number which fail to strike root is very large indeed; as a matter of fact it is to provide against this circumstance that as many as seven cuttings are planted where otherwise one would have been quite enough. This is obviously a most wasteful method even with cuttings from vines of no special merit, but where good and selected vines are concerned this is a serious handicap.

The difficulty can to a large extent be got over by adopting the practice of planting only rooted cuttings. Rooted cuttings can be had either by (1) planting a nursery of cuttings or (2) the layering of the vines.

In raising rooted cuttings from a nursery, the percentage of success is not likely to be any more than in planting cuttings directly in their permanent places. In order to be able to supply rooted cuttings to garden owners, two nurseries were put out this season, in which cuttings brought from Malabar were planted. The planting was done in the month of July, that is just about the season considered to be best for pepper planting. One nursery was put in Mr. Subramanya Bhatta's garden in Thenginakere, Tirthahalli Taluk and another in the Marthur Farm. The percentage of rooted cuttings in both these places was as below :—

Name of place.	No. planted.	No. rooted.	Percentage of success.
Thenginakere	2000	300	15
Marthur Farm	2000	150	7.5

Possibly the long transport of the cuttings by road over a distance of 200 miles may have had something to do with the low percentage, and possibly also the cuttings were not all in the proper stage of ripeness for rooting readily ; anyhow the percentage is discouragingly low.

It was also attempted to grow a nursery from cuttings only about a foot in length instead of the usual 3 to 4 feet length of cuttings with the object, of course, of making a more economical use of planting material : this, if successful, would mean a great advantage indeed. But here too the percentage of success was very low indeed ; the success which is said to attend this method in the Straits Settlements where it is stated to be a common method has not been attained here. Further trials are however being made to see if we cannot obtain much more satisfactory results. But low as the percentage of rooted plants is, it has the advantage over the planting of cuttings directly in the permanent places, in that we can be certain of one good rooted plant for each standard in the year of planting itself, instead of the loss of a whole season involved in the former method.

The second method of getting rooted plants is by layering. Layering appears to be so easy and satisfactory in results that it

can be regarded as the best to be adopted. The pepper vine branches root with extraordinary facility during the monsoon month of July, that the question of inducing it to root by any special treatment need not at all arise. We have only to choose among a number of methods of layering according to local circumstances. The following methods of layering are therefore described :—

(1) The vines, if they are sufficiently low, can be laid along the ground itself staked at suitable intervals, where they readily root ; the rooted branch may then be severed in the usual way and carefully removed from the ground with its new roots intact in a ball of earth.

Ground layering of the pepper vine, showing how the growing end of the layered branch is tied to upright supports of areca battens. Picture shows four branches layered in this way.

In another method of ground layering the vine branch taken for layering is not laid flat on the ground but the growing end of the vine beyond the layered node is trained on a short up-right of bamboo or split areca stem ; when the vine is ready for removal in the same way with its ball of earth this gives a rooted plant growing

erect which can be planted and tied to the permanent standard conveniently.

(2) In preference to such ground rooting, the rooting may be made to take place in special receptacles such as shallow baskets, bamboo hollows split lengthwise into two halves, or in areca sheaths. The baskets used for this purpose are about 2″ in depth and 18″ in diameter and made of bamboo or brush-wood twigs. It is stated that even cocoanut husks if they can be had of the proper size are used for this purpose. The bamboo hollows used are about 4″ in diameter and 18″ long; they are sawn across close to the node, so that a tall cylindrical receptacle is got; this is then split lengthwise into two halves thereby giving two semi-cylindrical hollows suitable for layering in. The branch to be layered is placed in this hollow containing moist earth with its growing end pointing towards the partition formed by the node and then allowed to root. After the vine strikes root and is severed from the parent, and thus made ready for being planted in its permanent place, the rooted cutting with the whole of the soil can be slipped into the hole prepared for it, and the bamboo hollow drawn out, for use in the next year.

Above-ground layerings of the pepper vine, showing two convenient receptacles used; *viz.*, split bamboo hollow above, and wicker basket below.

Where the branches to be layered are higher up and ground layering is not possible, then scaffolding has to be erected on which the baskets, bamboo hollows or areca sheaths have to be mounted. The photograph shows this method as adopted in the Marthur Farm. In all the above cases it is necessary to cover the node which is expected to root with a little more soil than may be necessary in the case of vines layered on the ground itself. for the sake of firmness, because it will not be possible to stake it down and prevent it from moving or otherwise being disturbed.

Still another method which gives rooted plants which lend themselves to ease in transport in large numbers is the one called "Marcotting". A lump of moist soil about the size of a lime is tied around the node to be induced to root, with a piece of cloth, a piece of gunny or even a bit of the thin membrane of the areca sheath. The rooting takes place readily inside this lump of earth.

Rooting in every one of the above methods is exceedingly rapid ; the layering is carried out in the middle or end of July and the rooted plants are ready in the end of August or early in September for severing and putting down in their permanent places. Where a vine of good quality has to be propagated from and where therefore as large a number of plants as possible have to be obtained from it, then the method of layering by any one of the above ways is the best one to adopt. The selected mother plants on the Marthur Farm from which propagation is being made were made use of in this manner during this year, and ten times as many *rooted plants* have been obtained where formerly only two or three plain cuttings were being obtained, with all the risk of the majority not rooting at all when planted out.

Branches for layering in any one of the above methods are usually those which spring from near the base of the vines. In order to obtain a good number of cuttings or layerings from such branches, they should be grown long and clean without being allowed to lie and straggle on the ground and be damaged by trampling or climb up on the standard. For this purpose it is a convenient method to have a forked stick about 3 feet high planted near the foot of the vine ; the

Layering upper branches of the Pepper Vine on the Marthur Farm, showing the scaffolding for keeping the baskets.

selected branch should be carefully lifted from the ground and coiled in the fork of the stick and allowed to grow there, the fork serving as a kind of perch for the coiled bundle of the branch. Such an arrangement is very necessary in the years when digging and manuring are given to the garden, and should be carried out immediately prior to the commencement of these operations. Propagation from such branches is the general method and the plants raised in this way come to bearing in the normal way, that is to say, in about 4 or 5 years. It is possible however to get rooted plants or cuttings which will bear in the year of planting itself. For this purpose the bearing branches themselves of a vine in full bearing will have to be made use of. Such a proceeding however can be seldom resorted to, and vines in their prime of bearing cannot be sacrificed in this way. If however owing to the death or breaking of any areca trees in the garden, the bearing pepper vine trained on it has to be removed—a not uncommon occurrence in an areca garden—then such a vine can be made use of for taking cuttings or layerings of this kind. A few vines of this kind on the Marthur Farm were made use of in this manner in the current year and a number of them are already bearing. Garden owners of experience state that such vines will be short lived, which may perhaps be true.

The rapidity and certainty with which gardens can thus be stocked with good vines by the methods described above can thus be readily realized. It is recommended therefore that garden owners in trying to increase the number of pepper vines in the gardens should firstly select as parent plants only the hermaphrodite plants and among them those known to bear best in the garden, and secondly secure *rooted plants* from these by adopting the method of layering in any one of the different ways described above, which may be convenient to them.

The Worm Parasites of Domesticated Animals with Special Reference to Parasitosis in Sheep.

BY

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In all warm countries parasites play an important rôle in the disease of live-stock, and the Mysore cattle certainly have their share. Parasitic diseases are about as important as bacterial diseases, but it is more difficult to estimate the damage caused by them, because most of them are present throughout the year. Bacterial diseases, on the other hand, manifest themselves suddenly and cause severe losses at one time but parasitic diseases continue, causing animals to lose condition, become unthrifty and less capable of producing meat, milk and wool for which these animals are raised. Sheep appear to suffer more severely from parasitic worm infestation than any of the other domesticated animals. Possibly this may be due to the fact that sheep pastures are most frequently permanent pastures, suitable for grazing sheep only, so that rotation by cropping or by grazing with other animals incapable of infestation by the common sheep parasites is often impossible.

Parasites are living beings (or plants) which live on or in other animals (or plants) which are called hosts. The parasite benefits by such association, but the host does not. It may not be the purpose of the parasites to kill or damage their hosts, but this usually follows either through the presence of too large a number of parasites in one host, or through other causes which result from the mode of life of the parasites. Any one worm cannot live equally well in all kinds of animals, but each kind of worm is restricted to certain particular kinds of hosts. It may be said in general that closely related animals, as, for example, cattle and sheep, or horses, mules, and donkeys, harbour almost the same worms or closely related kinds of worms, while there are very few which live in animals of quite different kinds. Worms of mammals are quite different from those of birds, and there are generally none common to both kinds of hosts. But what is important to us is the fact that many wild animals, such as, wild pig, deer, jackal, etc., have practically the same worms as those of

some of our domesticated animals, and these wild animals contribute to some extent to infect the pastures. Different groups of worms differ very much in their development and life history, but in general it is important to know that the parasitic worms have developed the function of reproducing their kind to a remarkable extent. In the case of round worms a single female may lay as many as ten thousand eggs in a day, and this is, in a way, necessary, because the worms can only lay eggs and leave them to whatever chances they may have outside the body of the host, where conditions are often adverse for the development of the eggs, and the majority of them perish. However, when conditions are favourable, the danger becomes very menacing. Moisture and warmth are the most important factors favourable for the development, so much so that as the summer approaches and the first rains begin to fall, the danger begins. If we consider that one sheep with a moderate infection of, say, wire worm, passes in its droppings about 15 to 20 thousand eggs a day, it can be understood that a flock of a few hundred sheep can make the pasture teem with young worms within a few days. Therefore in the case of worms for which we have efficient drugs to kill them in their hosts, every flock owner should endeavour to cleanse his flock before the rains begin, so that they cannot infect the pasture to a great extent. As the sheep may generally look healthy until they show signs of heavy infestation, flock owners do not trouble themselves to get them treated early, but after the damage is already done by the worms it is too late for preventive measures being adopted, while an early dosing may go far to minimise the danger and loss from parasites during the summer. The health of human beings is also sometimes endangered by worm parasites of domesticated animals, and it is therefore desirable that every flock owner should know something about the different kinds of parasites, their general character, and life history, effects, prevention, treatment, etc.

Parasites are divided into three classes, *i.e.*, Flukes (Trematodes), Tapeworms (Cestodes), and Roundworms (Nematodes). They differ widely from one another in appearance and mode of life.

Flukes are not worm-like in appearance, but rather leaf-shaped (like the liver fluke of cattle and sheep) or thicker and pear-shaped

(like those found in the first stomach of ruminants). They have two circular suckers, of which one is situated round the mouth at the anterior end of the body and the other towards the middle or posterior end. With their suckers they fix themselves to the tissues of the host. The gut divides into pouches or intestines which end blindly. Some flukes suck blood, while others live on the intestinal contents. Each individual has a complete set of male and female organs, and they lay eggs which pass out through the fæces of the host. After the eggs have passed, they hatch if sufficient moisture is available and temperature is suitable. The larva that escapes from the egg, is very minute, and requires moist surroundings. It must soon find an intermediate host, as is always necessary in the case of flukes for the development of the young stages, or else it dies. The intermediate hosts are invariably snails of some sort or other, and the larva, on finding a suitable snail, penetrates actively into its body, where it grows and multiplies into a large number of young flukes, or they may leave the body of the snail while the latter is still alive. The number of young flukes may become so numerous that the snail dies setting free the young flukes. These young flukes swim about in the water and eventually settle on blades of grass, where they form a kind of protective shell around themselves. It is by swallowing these young flukes with the grass that the final host gets infected. Flukes generally occur in the liver, but may occur in any part of the digestive tract and sometimes in the lungs.

Tape Worms have an appearance which is adequately described by the name itself. They are, of course, flat, and usually of considerable length. Each worm has a head and a body composed of numerous successive segments. The head is furnished with 2 or 4 suckers on its sides and usually a ring of hooks in front with which the worm attaches itself. The segments of the body are small in front, and become progressively larger towards the posterior, which are therefore the oldest of the chain. As the worm has neither mouth nor gut, it is not a blood sucker, but absorbs its food through the whole body. Each segment contains a complete set of male and female organs, and in many cases even two such sets, so that every segment is actually an independent entity. As the segment grows and

is pushed further and further away from the head by the younger segments, its organs develop. The eggs are not laid by the segments, but are retained in a sac-like part which gradually fills the whole segment, and consequently the old segments are merely small bags of eggs. They break off from the body, and pass with the fæces of the host where they break up and liberate the eggs. An intermediate host is always necessary for the development of the young stages in this group of worms also, but this differs from the flukes in that the eggs do not hatch in the free state, but only after they have been swallowed by the proper intermediate host. Besides, the larvæ do not leave the intermediate host, but must be swallowed by the final host together with the intermediate host or parts of it. After the eggs have been swallowed by the intermediate host, they hatch in the intestine or stomach, and the larvæ bore into the walls of the gut, so as to reach a blood vessel. They are then carried by the blood stream to various parts of the body, but usually, as they can develop only in certain organs, those that are carried to such organs will develop into cysts, and the rest die. Only the head of the worm will develop in the cyst, and as it cannot develop any more in the intermediate host, it has to wait until it is transferred to the final host. After having been swallowed by the latter the cyst bursts, liberating the head which attaches itself by means of its hooks and suckers to the wall of the intestine, and grows a body by producing one segment after another until a long chain of segments is formed. Tape-worms generally live in the intestines.

Round Worms have a real worm-like appearance, and they greatly vary from one another, some having elaborate arrangements of hooks, teeth, etc., for fixing themselves, while others are devoid of such organs. This chiefly depends upon which part of the body they occupy. These worms have a complete gut. Some of them are blood-suckers and are usually provided with teeth or similar structures with which they injure the tissues of the host so as to cause bleeding, while others feed on the intestinal contents of their host. The round worms are either male or female, and the latter generally lay eggs which pass out with the fæces of the host. The life history of the round worms is varied in nature and the development takes place either with or without an intermediate host, but

we will consider here only the simplest and commonest type in which the eggs hatch in the free state under suitable conditions of moisture and temperature. The larvæ have to develop further for some time under the same conditions, casting their skin twice in succession before they are able to live as parasites in their special host animal again. When they reach the infective stage they crawl up blades of grass, and are then swallowed by the host. If conditions are adverse, the young worms creep into the soil for protection and may remain alive in this way for a long time in the pasture. Having reached the stomach or intestines of the host they develop further, casting their skins twice more before they become adults, and begin to lay eggs. Wire worms and nodular worms of sheep are examples of this type.

From the above it can be seen that the knowledge of the life history of a parasite is of very great importance in combating it. One can usually find some point or other at which the life cycle can conveniently be broken, or at any rate a knowledge of the conditions necessary for the development of the free-living stage, is of practical use.

Effects and Symptoms.

It cannot be said that parasites are beneficial to their hosts as they must necessarily cause damage even though this may be very slight in certain cases. The harmful effects are produced in different ways, *i.e.*, by using too much of the food which the host takes for its nutrition, by sucking blood, by causing wounds through which causal organisms of other diseases may enter the system and thus causing severe damage to certain parts of the body, and finally by producing poisonous substances which are responsible for nervous symptoms, such as excitement, convulsions, paralysis, etc. Youth is always an important factor in the susceptibility of an animal to parasitic infestation, and the critical period in the life of a sheep is from the fourth or fifth month to about the eighteenth, and of this period the most dangerous time is just after weaning. General symptoms of worm infestation that can be noted in a sheep are, loss of condition, anæmia, paleness of the visible mucous membranes, such as those of the eyes and mouth, œdema, pot-belly, appearance of dropsical swellings under the jaw, periodic diarrhœa

and stunted growth. These symptoms are common to most of the serious parasitic infestations.

Prevention and Treatment.

"Prevention is better than cure," is very true in parasitic diseases, particularly in sheep. From what has been said of the general life history of parasites we can deduce a number of measures as—

(1) *Attention to pasture :*—Avoid marshy and low lying pastures, and tank beds for grazing animals. Pasture area may be divided into different blocks, and sheep grazed in rotation, so that infected areas of pasture may be free from parasitic larvæ which will take about three months after the removal of animals. Seasonal burning of grass lands is a valuable aid in the control of infestation. Wherever possible ploughing up of the land may be employed with advantage, particularly in wet areas. Badly infested areas may be treated with a top dressing of salt, lime or copper sulphate (about ten to twelve maunds per acre).

(2) *Attention to the source of drinking water :*—Usually surrounding a drinking pool there is a moist area where the grass grows luxuriantly, especially in summer. With all the animals coming to drink, a lot of fæces is dropped there, and it can be imagined what a worm-infested place this must be. Therefore particular attention should be paid to this point by avoiding or improving such places.

(3) *Periodic dosing with anthelmintics :*—As far as tapeworms are concerned we do not know much about the life history of many, and preventive measures are therefore, at present, of questionable value. Round worms are more important to us, particularly, the wire worms, for the reason that they are the greatest menace to the sheep industry, and periodic dosing is an efficient preventive. As these worms take about a month to develop fully in the sheep and start laying eggs, monthly dosing should be practised to kill them just before this time. Fresh infection, however, takes place as soon as the sheep return to infected pastures, but the multiplication of the worms may be arrested to a great extent by killing the worms that a sheep ingests in a pasture before they are able to reproduce.

A large number of drugs is in use for the purpose of removing worms from animals, and some of these actually kill the worms, while others damage them to such an extent that they can be removed by means of a purgative. All effective worm remedies are poisons, and must be used with care. An animal should be starved for some time before the drug is administered, as this makes the drug more effective against the worms, and often less poisonous for the host. The effect of starvation is to slow down the movements of the bowels, so that the drug will pass through more slowly, and its action on the worms will be prolonged. Moist food or water would cause the drug to become dissolved and absorbed rapidly through the intestines, so that its effect on the worms would be less and its danger to the host greatly increased.

From a test conducted here on sheep with different anthelmintics it has been found that a mixture of copper sulphate and sodium arsenite (4–1) is about the best for all practical purposes, as other efficient anthelmintics, as carbon tetrachloride, are much less convenient to use as they have certain disadvantages, such as increased cost, difficulty of administration, or high toxicity for sheep. Treatment with the mixture may be repeated at monthly intervals with the object of expelling parasites as soon as they become adults, or at any rate before they have time to deposit any eggs. Cumulative infestation of the pasture is also thus prevented to a great extent. The mixture is probably more efficacious against young worms than against older ones and repetition of the dose at monthly intervals is accordingly advocated.

Mode of Preparation.—

Copper sulphate 4 parts.
Sodium Arsenite 1 part. } Powder and mix well.

Dose:—4 to 10 grains according to the size of animals. Each dose is dissolved in 10 c.c. (about ⅔ oz.) of acidulated water regardless of the size of the animal. The necessary quantity of powder for a number of animals for the same age may be dissolved in the required quantity of water, the proportion of hydrochloric acid being about 14 c.c. (about ½ oz.) to 1 litre (1,000 c.c. or about 35 ozs.) of water. The powder should be dissolved in the acid before the water is added.

Directions for the use of the Copper Sulphate and Sodium Arsenite Mixture in Sheep :—Two doses of the mixture are indicated in the treatment of heavily infested flocks, but a single dose may be sufficient in some cases. As already described, the medicine should be administered in an empty stomach, and it is necessary therefore to withhold feed and water for at least 16 to 18 hours before dosing. In the case of double dosing the mixture should be administered during the early hours of the next morning preferably between 6–10 A.M. and all drinks of water should be rigorously stopped during that day, and also the following day. When the second dose is administered, the same precautions with regard to water should be taken. But it is suggested that the sheep be allowed to graze for two hours toward the evening of these two days on which the medicines have been administered. It should particularly be noted that during these two days when all the sheep are dosed and not watered, rock salt and salt licks should not be allowed.

The same directions hold good in cases where single dosing is practised, except that the period of withholding food and water should be only two days.

The Civil Veterinary Department will be glad to make available to sheep owners the complete worm medicine given above.

SELECTIONS.

Instructions for Making Compost.

Collect all weeds, grass, leaves and other garden and household rubbish and allow them to accumulate in a pit. When work in the garden is slack, take out enough of this material to form a heap about 6 feet long and 2 feet high—chop any long stalks into small pieces.

Take about a maund of fresh, concentrated cow-dung (not mere litter) and make into a thin "soup" with water, and thoroughly moisten the heap with it. *Keep moist* from day to day with occasional stirring until the temperature rises and then falls, and the mass becomes quite friable and has a good "earthly" smell and brown colour.

This fermented material constitutes the "starter" or "activator." Having obtained a good "activator" which contains abundance of the organisms required, further quantities of material can be fermented more rapidly.

One-third of the bulk of the heap of "activator" may now be added to new chopped material, and the whole well mixed and kept moistened with cow-dung solution.

Cow's urine gives better results than a decoction of cow-dung but cannot always be obtained. Night-soil is better still but may cause trouble with the *Malis*. Bone-meal has been added with useful results but may also cause trouble.

In the absence of the above materials, a solution of Sulphate of Ammonia, together with a little powdered *kankar* to prevent acidity, or ADCO mixture, containing both nitrogen and phosphate, may be employed.

In all cases only enough of the nitrogenous material should be added to make the total percentage of nitrogen present about 2 per cent on the dry matter.

As soon as fermentation is complete, one-third of the heap may be removed and stored in a pit, another third part of fresh material added and the process repeated.

The cost is mainly labour, but as the work is done in spare time it need not be heavy.

Khanka or *Kankar* is a crude carbonate of lime, which occurs in pockets, or fairly widely distributed, according to the locality. There is a good deal to be found in the United Provinces and the Madras Presidency.

ADCO mixture varies according to circumstances. The following are the analyses supplied by the makers :—

	Parts per cent of		
	Nitrogen.	Phosphoric acid.	Potash.
Complete ADCO mixture	9.0	6.7	*Nil.*
ADCO Accelerator	3.2	6.0	*Nil*

ADCO is short for Agricultural Development Company. This company is a private concern operating at Harpenden, England, to supply material for the preparation of artificial farmyard manure, according to the process originally patented by Messrs. Richards and Hutchinson, which is referred to in Bulletin No. 5 of the Department of Industries, United Provinces. ADCO mixtures are made from substances like ammonium phosphate, cyanamide and urea.

ADCO mixtures are supplied by Messrs. Shaw Wallace & Co., Bankshall Street, Calcutta. The complete mixture is sold at Rs. 15 per cwt., ADCO Accelerator at Rs. 12 per cwt., both f. o. r. Calcutta.

About 7 lbs. each of sulphate of ammonia, *kankar*, or ADCO mixture may be added to each 100 lb. of raw material. The ADCO people advise one and a half cwt. of their product to one ton of the original dry material, which is about 7 per cent or 7 lbs. to 100 lbs. It is necessary to add a larger proportion than this of cow-dung or night-soil, since the percentage nitrogen content in them is less than in the artificial materials just referred to. They are best added, as stated above, in the form of a thin decoction, fresh quantities of which may be added day by day in order to keep the heap moist, until the total is sufficient to give 2 per cent of nitrogen. On an average we may say that the total amount of night-soil or cow-dung required will be about 20 per cent or less of the *Katchra* or other waste material.

It is desirable, if possible, to mix bone-meal with the organic waste in the proportion of about 5 lbs. to 100. If good lime can be obtained, rather than *kankar*, not more than 5 lbs. per 100 of dry lime will be required to mix with the organic waste. The lime can be made into a saturated solution and used to moisten the heap. *The Agricultural Journal of India*, Vol. XXV, Part V.

Lactating Dairy Cattle need Plenty of Water.

Trials show Milch Cows consume more than sixteen gallons daily.

Water is a very important factor to consider in the nutrition of lactating dairy cattle when it is considered that approximately 87 per cent of milk, as well as a large percentage of an animal's tissues, is in the form of water.

The chief functions of water in the animal body are to dissolve the food material and to serve as medium of its distribution, to remove waste products from the body cells, and to control the temperature within certain limits by means of evaporation.

According to one investigator, approximately 56 per cent of the water consumed by a dairy cow is eliminated in the fæces, about 13 per cent through the kidneys as urine, 12 per cent through the skin, during the winter, and 15 per cent is used to produce milk. During the summer, approximately 27 per cent of the water may be eliminated through the skin compared to 12 per cent during the winter.

Although water is of prime importance to the body processes, very little data have been reported relating to the water consumption of lactating dairy cows.

In connection with an experiment conducted by the dairy section of the experiment station, water consumption of 10 lactating dairy cows was measured over a period of four months by means of placing meters on the individual drinking cups of the cows. These meters were read daily. A few very interesting observations were made.

The total and average daily milk production and water consumption of the 10 cows for the four months period is shown in Table I. These trials extended from March 25, 1929 to July 22, 1929.

TABLE I.—*Showing Total and Average daily milk production and water consumption.*

Animal No.	Total milk produced.	Average daily milk production.	Total water consumption.	Average daily water consumption.	Lbs. of milk per gallon of water.
	Pounds.	Pounds.	Gallons.	Gallons.	Pounds.
226	5,774.3	48.1	1,864.0	15.53	3.10
225	4,746.5	39.6	1,822.5	15.19	2.61
229	4,773.0	39.8	1,791.0	14.93	2.67
187	6,254.4	52.1	2,136.75	17.80	2.93
168	5,855.4	48.6	2,304.50	19.20	2.53
232	5,486.8	45.7	1,962.5	16.35	2.80
230	3,437.5	28.6	1,614.75	13.46	2.12
189	5,043.7	42.1	1,867.75	15.56	2.71
174	5,718.2	47.7	2,214.25	18.45	2.59
150	6,879.6	57.3	2,441.50	20.35	2.82
Average ..	....	44.0	....	16.68	2.69

According to Table I the 10 cows produced an average of 44.0 pounds of milk daily and consumed an average of 16.68 gallons of water daily

during this period or approximately 140 pounds. For every gallon of water consumed, they produced 2.69 pounds of milk, or, expressed in another way, these animals consumed about 3.4 pounds of water for every pound of milk they produced.

Effect of Temperature on Water Consumption.

A further study of the data obtained on this experiment revealed that the variation of atmospheric temperature had an effect on the water consumed. As the average daily temperature rose, the water consumption also rose and *vice versa*.

Because of the large amount of water required by lactating cows, as shown in this experiment, it is apparent that dairy cows should have free access to an adequate supply of good water. This is probably as necessary as a well-balanced and adequate food supply.—*The Quarterly Bulletin*, Agricultural Experiment Station, Michigan State College of Agriculture and Applied Science, Vol. XIII, No. 1.

Arabian Coffee.

By R. W. R. Miller, B.A. (Camb.), A.I.C., Dip.Agri. (Cantab.)

Various authorities have laid down that Arabian Coffee should not be grown at less than three to four thousand feet above sea level, but with careful attention to cultural methods the crop can be successfully grown where the shade temperature does not rise above 95°F. or fall below 42°F.

The term "Arabian" includes in general practice numerous varieties of which Bourbon, Mocha, Blue Mountain, Jackson's Hybrid and Kent's Selected are typical examples.

In considering the type best suited to any particular conditions it is well to bear in mind that coffee is a perennial crop, and to remember that coffee trees planted by the slaves in Jamaica are still producing a bean, which commands the highest price obtainable in the world to-day.

Coffee demands a good deep rich loam, which neither dries out quickly nor becomes water-logged, and like most tropical crops, the distribution of the rainfall is of greater importance than the annual total. It can safely be said that in districts where the rainfall is less than two inches in any one calendar month coffee cultivation is liable to prove a hazardous business, unless irrigation water is available.

The system of farming which the experienced planter aims at is one which will bring him in a regular crop each year, rather than a bumper crop every third or fourth year and a crop moreover which by its extreme demands on the plant's virility leaves the estate open to the attacks of the several diseases to which coffee is unfortunately liable.

Let us assume that the intending planter becomes possessed of virgin forest soil. He has first to decide on the acreage he intends to put under coffee. Under average planting conditions he would have approximately 600 trees per acre or 60,000 to one hundred acres, and as it is essential that regular inspections of all the trees should be made, it can be laid down as an axiom that every hundred acres of coffee demand the undivided attention of one overseer.

Let us not forget that a coffee estate producing one hundred-weight per acre costs the same to cultivate and bring into bearing as land producing five or six times as much.

Before preparing land for the nursery, which should be near permanent water (to save labour in the daily watering), the planting programme must be settled. Given a six weeks planting out season it is safe to assume that one man cannot supervise thoroughly more than a twenty-five acre planting, though where additional skilled supervision is available this can be increased in proportion.

There are roughly about 500 coffee seeds to the pound and for every acre an allowance of three pounds of seed (with a 66 per cent. germination) should be made. As for the last six months before planting each seedling will occupy thirty-six square inches of ground, the following data may prove useful:—

To plant 1 acre a nursery 100ft. × 40ft. is required.
To plant 10 acres a nursery 100ft. × 400ft. is required.
To plant 25 acres a nursery 250ft. × 400ft. is required.
To plant 50 acres a nursery 500ft. × 400ft. is required.

Beds should be prepared the length of the nursery and four feet wide with an interval of three feet between the beds. By this means it will be possible to inspect and handle all seedlings with the least inconvenience. All coffee land, for a nursery or for field planting, should be cleared and thoroughly uprooted. Even leguminous trees, which appear likely to prove useful as shade, should be removed, as large trees alter the alignment of the coffee bushes and diminish the number of plants per acre.

The land should be thoroughly cultivated and cleaned, and particular attention should be paid to the removal of all creeping grasses and rotting roots, in such time that nine to ten months are left between the date of planting the seed in the nursery and the actual transfer of the seedlings to the field.

(The question of planting at stake is not recommended with this crop, as it is essential from every point of view that a block of coffee should present an even stake.)

The choice of seed is wide and, if possible, the planter should himself visit a neighbouring farm and himself select the bushes from which his seed may be taken. In this respect it is well to remember that the coffee crop, though for the first few years it is produced on the primary branches, will eventually be borne on the secondaries and tertiaries and the selection of seed trees should only be made amongst those which have sturdy primary branches, of at least three quarters of an inch in thickness as good secondaries can never be produced from whippy parents.

In this respect, experience has shown that those parent trees whose first leaves are of a copper colour on unfolding, prove slow steady growers with a strong constitution, and it cannot be too strongly emphasized that the successful coffee planter's motto should be "slow and steady". Moreover this type throws as a general rule remarkably few "rogues" compared with most other varieties.

The seed should be planted, in parchment, hilum downwards one inch deep, one inch apart in the row and with four inches between the rows. The soil should be pressed down firmly and a daily watering made late every afternoon through a fine nozzle.

Shade, consisting of grass or palm leaves, should be erected from three feet to four feet above the ground (not lower, as otherwise inspection is made more difficult). After six weeks to two months, germination should take place and after the cotyledons have deepened in colour the seedlings should be removed and, after having their roots washed and carefully inspected, should be planted out in other shaded beds, six to nine inches apart, depending on the length of time it is contemplated keeping them in the nursery.

The life of a coffee bush depends on the health and efficient working of its tap-root and therefore at each stage of transplanting the roots should be washed and each root stock closely inspected.

At the same time as the nursery is put in hand the area intended for the first year's planting out should be cleared, stumped, uprooted, all the cleared material burnt and spread evenly over the soil. At this juncture it is necessary for the planter to decide whether, or to what extent, he intends to shade his crop. The various authorities differ considerably on this point and the writer's opinion is that this is a question that each planter must decide for himself.

It is recommended that windbreaks of *Grevillea robusta* should be planted every hundred yards throughout the plantation, at right angles to the prevailing wind, and that shade trees should be planted at 30 feet intervals throughout the coffee area. For shade, varieties of *Albizzia* (not the *mucronata* variety which is liable to lose its branches which fall

and break the coffee) are recommended, but in all probability the planter will be able to choose a local tree, belonging to the *Leguminosæ*, which may prove a suitable shade. It should always be borne in mind that shade should be only sufficient to prevent overbearing.

Starting off in this way, as his coffee grows the planter can decide whether the shade is too extensive and so diminish it until it is requisite to the conditions which obtain in his plantation.

Shade undoubtedly limits the crop, but it preserves the moisture in the soil and so renders the plant less liable to suffer from pests and disease. On the other hand pests, such as the coffee bug (*Antestia*) delight in heavy shade. On the whole it can be said that a moderate shade will usually be found beneficial.

The land required for planting out should receive a thorough cultivation till a fine tilth is secured and then staked out for planting.

Planting is usually done either eight feet by eight feet, nine feet by nine feet, or ten feet by eight feet and the respective number of trees is 680, 538, and 544 per acre. The latter is recommended as one in which inter-cultivation can be done either by a small mechanical cultivator or by a small plough drawn by a single mule or ox. Holes should be prepared two and a half feet square and two feet deep and the earth removed from the hole should be exposed to the sun's action till immediately before the planting season.

When the transplanted seedlings in the nursery have 10 to 12 leaves and when the area to be planted has received a good soaking and there is the prospect of a further six weeks rainy season, planting can commence. This is undoubtedly the most important operation in the life of a coffee estate, for any faults in the root system will in all probability not be detected until the first heavy crop has been taken off four or five years hence, at which time any supplied plants will be severely handicapped by the height of the surrounding coffee and can only become willowy bushes incapable of pulling their weight with the rest of the estate.

Planting.

As coffee is a surface feeder the customary practice is to nip off the tap-root before planting out in the field so that the lateral surface roots may develop to as great an extent as possible. It cannot be emphasized too strongly that the future prosperity of a plantation depends to a very considerable extent on the care which is exercised in the early stages of the plant's growth.

One overseer should be stationed in the nursery to watch over every plant as it is lifted and another should supervise the actual planting out in the field. As a rule, it is found that one man can only watch over

the efforts of, at the most, six planters-out, as otherwise the number of plants which do not "take" will be high.

After planting the earth should be turned back leaving a collar of earth around the roots which on settling should not sink below ground level.

After-cultivation.

Once the young coffee trees are established in the plantation it is well to inter-plant with some suitable green manure to enrich the humus and at the same time to keep the soil cool by not exposing it to the direct rays of the sun. Different coffee countries have their different cover crops but in the writer's experience a liberal sowing of string beans is hard to beat. These by covering the ground quickly lower weeding costs and improve the soil texture considerably. Moreover where the crop is being established on a narrow financial margin the seeds can be sold off the farm for a substantial sum. Where, however, an immediate financial return is not of the first importance, the cover crop should be turned in as the first pods are beginning to ripen, as by this means the soil obtains the maximum benefit.

Mulching and Manuring.

The value of a heavy grass mulching is too often not realized by coffee planters. In the Blue Mountain district of Jamaica, planters grow two acres of Guinea grass for mulching each acre of coffee and in the writer's experience a heavy grass mulch, some nine inches in depth, does more to keep the plants in good health and ward off disease than any other treatment.

Coffee, like other members of both the lower and higher orders of life, suffers most when carrying its crop and the timely application of a nitrogenous fertilizer keeps the plant in good heart and tends to avoid the "gone back" appearance which so many coffee plantations exhibit after the crop season.

A light dressing of phosphates usually proves beneficial, but the coffee crop, as a rule, does not respond to treatment with potash.

Where manure is applied it is well to bear in mind that the feeding roots of the coffee plant are mainly concentrated in a circumference immediately below the outermost leaves of the bush and the manure should be forked into the soil at these points.

Irrigation.

Where coffee is grown in regions which receive at least two inches of rain during every month of the year irrigation is, as a rule, unnecessary; but where, as occasionally happens, resort must be made to this method of keeping the plant alive, every effort should be made to avoid the

washing out of the soluble plant food from the soil. Too often irrigation only means the leaching of the soil and the exposure of the surface roots to the hot tropical sun. Such "soil-washing" can achieve no lasting benefit and moreover each irrigation brings the plant roots nearer the surface and renders increased irrigation essential.

Irrigation, as with other artificial stimulants, has its disadvantages, one of the chief of which is the extreme liability of the coffee plant to produce a "flush" of flowers some two to three weeks after each irrigation. This flushing where irrigation is a regular part of the cultivation programme, results in the necessary picking all the year round of fly crops apart from the main crop, and the plantation never really enters on a true resting stage.

After Cultivation of the Soil.

When coffee is three to four years old it is safe to assert that with a correct spacing the roots of the bushes will be contiguous all over the estate. It will therefore be apparent that cultivation with a heavy or light hoe can only be attended by the destruction of a considerable number of the coffee rootlets and a corresponding diminution of the plant's ability to absorb its food supply. All that the soil needs is a thorough æration and this can be best accomplished by means of the forked hoe which should be used to prick open the soil without interfering with the root system. In this way alone can the soil be thoroughly ærated and planters too often forget that roots as well as leaves must breathe.

Where weeding is a part of the plantation system the weeds should be cut off close to the ground before they seed and not uprooted as clean and thorough cultivation exposes the soil too much to the devastating rays of the tropical sun.

Pruning.

Pruning is next to planting and picking, perhaps the most important of the coffee planters' field operations. Unskilful pruning can do more to ruin a coffee plantation than would be deemed possible and therefore only skilled and well-trained workers should be employed in this task.

There are several systems of pruning observed amongst coffee growers and these in the main depend upon the available labour supply.

The chief systems are known as :—

(1) Ordinary pruning; (2) The Agobiada system; (3) The Costa Rica system.

In the first and third systems the plant is cut back at three stages of its growth, *i.e.*, knee-high, loin-high and breast-high; these three checks tend to stimulate a steady growth of primary branches fitted to carry subsidiary branches capable of bearing several subsequent crops.

A striking example of the value of this cutting back was observed by the writer amongst the coffee plantations of Kilimanjaro in 1926. A planter, who in 1923 had planted over five acres on the nine feet by nine feet spacing, found himself with a superfluity of plants in his nursery. He used these by interplanting with the idea of removing the interplants after taking one crop off them. While the original plants had been put into well prepared holes, the surplus plants in his nursery were put in anyhow. To avoid overcrowding his original plants he cut back the interplants. When the writer visited the estate the first crop had been taken off. While the untrimmed plants exhibited all the usual signs of exhaustion, yellow leaves attacked by rust and whippy branches, the cut back transplants showed a vigorous growth of good healthy wood bearing an abundance of glossy, dark green leaves. The contrast was so vivid that the field presented the appearance of a chequer board of green and gold.

In the first system the usual practice is to remove every alternate secondary growth on each side of the stem as shown in the diagram (Fig. 1, see page 268). This avoids overcrowding of the branches and permits the free interplay of air through the coffee tree. The unwanted shoots should be removed as the bark begins to show brown with a sharp pair of seccateurs and any tearing of the tissues should be very carefully avoided.

The Agobiada system starts shortly after planting and consists of bending back the main stem and pinning it to the the ground by a cut twig of hard wood (Fig. 2).

Three or four branches are then allowed to grow and these are cropped till exhausted, and as one branch has finished its economic usefulness, another is allowed to succeed it.

The Costa Rica system is mainly resorted to where an extensive labour supply is not available, for it must not be forgotten that pruning induces extra growth and necessarily results in an increased need for pruning. In this method the bushes are cut back when knee-high and then two main stems are allowed to grow (in the first system only one stem is favoured); at breast-high the process is repeated and so four stems are left. In theory, the branches are supposed to hang over with the weight of the crop, but this is unfortunately not always the case (Fig. 3).

The branches below the "cut" are allowed to crop once or twice and are then removed until eventually there are no bearing branches below the point at which the stem was first capped.

In the writer's opinion the last two methods of cultivation limit the economic life of the tree and the slow but sure method of growing

the plant in accordance with the demands of the climate and the soil rather than pandering to the exigencies of the labour supply is the only one which can ensure permanent success.

In short, where a sufficiency of labour is not available, it is better to avoid undertaking the, at all times, hazardous adventure of coffee planting.

Picking.

The picking of coffee should be organized before the crop is ripe. Like cotton the crop is harvested over a period and in a well-regulated estate five pickings, at most, should be sufficient to garner the whole crop.

Coffee picking is always conducted by "task" and no coffee which is not perfectly ripe should be paid for. Coffee is always bought on quality and the admixture of unripe cherries can only lead to an undesirable diminution in the price per ton.

Care should be exercised that the coffee bushes are not damaged, as although damage in picking is not so serious as in the case of cocoa, serious losses may be caused by unsupervised picking.

Preparation.

The coffee seed as in the case of several tropical crops such as sisal and flax requires fermenting before marketing. After picking the coffee is "pulped", that is to say, the fleshy fruit is removed from the seed by mechanical means. Usually the fruit is run down a water channel and passed through either a disc or breast pulper. Both types have their advocates but it can be safely stated that for a large estate, a combination of both types such as that made by Benthall is most satisfactory.

After pulping the coffee is fermented. The coffee cherry consists of fruit and seed. The seed is surrounded by a thin layer of vegetative skin, known in the trade as "parchment". This parchment is attached to the fleshy part of the fruit by a gelatinous "glue". This glue is chemically a pectin. Pectins on fermentation are turned from sticky, insoluble resin-like substances into soluble pectoses. The pulped coffee is placed in heaps, as in the case of cocoa, and allowed to ferment over 24 to 60 hours, depending on the temperature. When fermentation is complete, the seed is harsh to the feel and has lost all its slimy touch. Over-fermentation should be seduluosly avoided as it is bound to result in a discoloured bean with bad liquoring qualities.

After Preparation.

The coffee should now be washed and thoroughly dried on close-meshed wire trays. Mechanical drying is necessary where large crops are harvested but with medium crops sun drying is usually resorted to.

The crop is considered dry and marketable when a bitten seed shows no indentation. The crop is shipped for the most part in parchment in bags which weigh twenty to the ton as it has been found in general practice that coffee cured and cleaned (of its parchment) in London fetches a better price than that treated locally.

Pests and Diseases.

The present article is not the place to describe either briefly or in detail the troubles which coffee is heir to, but it can be briefly stated that sound agricultural practice limits the ravages of diseases and pests and that, perhaps as with no other crop, coffee responds better to judicious cultural conditions.—*Tropical Agriculture*, Vol. VII, No. 10.

Soil Surveys and their Utilization.

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For some years past, many countries of the world have engaged in the making of soil surveys. Various methods have been suggested and tried, and numerous reports published. Of special interest is the work in the United States which, for the past thirty years, has proceeded without interruption under the guidance of the Bureau of Soils and, later, of the Bureau of Chemistry and Soils of the United States Department of Agriculture, in co-operation with the various States. This work has been very extensive and has covered all parts of the Union. It has also embraced the surveying of a great variety of agricultural, climatic and soil conditions, so that it might well be considered an outstanding example of the successful application of soil surveys to the classification of the soils of a nation. There are no available data regarding the extent of the soil surveys completed to date within the United States, but, up to and including the year 1912, the survey of over 333,000,000 acres had been completed. It is impossible to say what acreage has been added during the past seventeen years, but it is quite possible that the present surveys would show published work concerning well over 600,000,000 acres.

A soil survey may be defined as the identification, classification and mapping of the various soils of any given district. It should embody fundamentally a detailed study of their present and possible future utilization—the methods of cultivation and fertilization now in use on the various soil types, and suggestions for their improvements. Such important factors as crop adaptations and systems of farming as applied

to the different soils also receive careful consideration. The soils recognized are then classified and their occurrence and distribution accurately recorded on a map. The completed soil survey with the accompanying report and map represents a complete inventory of the soils of the particular district, together with many important facts concerning their cultivation, treatment and utilization.

In America, soil surveys have been more extensively made and utilized than anywhere else in the world. It may be of interest, therefore, to describe briefly the American system of soil classification, which has worked very satisfactorily in the United States, and to refer to some of the field methods, and to the value of the work to varied agricultural interests.

The American Method of Soil Classification.—The most important principle of the American system of classification is that it is an economic one, and that soils are defined and classified on the basis of the *characteristics of the soils themselves*, rather than in their relationship to other factors, such as geology, climate, natural vegetation or crop. The unit of classification is the "soil type", which is a combination of a "Series Name" and a "Class (Texture) Name" as, for example, "Sassafras Loam" in which "Sassafras" indicates the "Series Name" and "Loam" the "Class (Texture) Name", the two names together representing "the soil type".

The Soil Series.—The determination of the Soil Series is based upon the following soil characteristics:—

I. Geological Origin of Soil Material.
II. Mode of Formation.
III. Topographical Position.
IV. Drainage.
V. Profile.

The Soil Class (Texture).—In the United States it is recognized that all soils are made up of the following soil separates:

Fine Gravel	 2	to 1	mm.
Coarse Sand	 1	to 0.5	,,
Medium Sand	.. .. .. 0.5	to 0.2	,,
Fine Sand	.. .. .. 0.2	to 0.1	,,
Very Fine Sand	.. .. .. 0.1	to 0.05	,,
Silt	.. .. .. 0.05	to 0.005	,,
Clay	.. .. .. 0.005	to 0	,,

together with more or less organic matter.

The content of organic matter in soils, except in rare cases, is small, seldom amounting to more than 10 per cent. in agricultural soils and

usually much less. Furthermore, if thoroughly decomposed, as in the average soil, it is extremely fine in grain and falls within the clay group of the soil separates. It is evident, therefore, that the texture of most soils depends mainly upon their mineral composition. It is further evident that the heaviness or lightness(texture) of any soil depends upon the relative proportion of the various soil separates of which that soil is composed. Experience has shown that a great range of combinations exists and therefore twenty textural groups are recognized. These groups are as follows :—

(1) Coarse Sand.	(11) Fine Sandy Loam.
(2) Sand.	(12) Very Fine Sandy Loam.
(3) Fine Sand.	(13) Loam.
(4) Very Fine Sand.	(14) Silt Loam.
(5) Loamy Coarse Sand.	(15) Sandy Clay Loam.
(6) Loamy Sand.	(16) Clay Loam.
(7) Loamy Fine Sand.	(17) Silty Clay Loam.
(8) Loamy Very Fine Sand.	(18) Sandy Clay.
(9) Coarse Sandy Loam.	(19) Clay.
(10) Sandy Loam.	(20) Silty Clay.

If gravel, stones or shale be present in such quantities as to influence the economic value of the soil type the terms "gravelly", "stony" or "shale" are used in addition to the class name.

In the actual determination of the soil class (texture) in the field only the surface layer (6 in. to 12 in.) receives consideration and the class of the soil type is named accordingly. The other characteristics of the particular soil type under observation are also examined in the field and the type is classified in a definite "Soil Series" according to these characteristics. The series name, together with the class name, designates the "Soil Type".

Making the Soil Map.—In the actual soil mapping in the United States, the fieldmen available in a given area are divided into field parties, two or more men working together in each party. Three men often work together to advantage. Automobiles equipped with special speedometers for the measuring of short distances are used for transportation. The usual procedure is to choose each day a circuit for survey surrounded by roads or lanes, one man remaining with the car and surveying the soils along the roads, the other men walking through the fields also identifying and mapping the soils and joining the car at a previously appointed place. The soil boundaries mapped by the various men are then discussed and joined. Each man is, of course, equipped with a base map upon which the soil boundaries are placed, or having no base

map, constructs his own with the assistance of a plane table. One man, usually the one having the greatest experience, is placed in charge of all the parties and is responsible for the planning and conduct of all the field work. At the completion of the survey, he is also charged with the preparation, for publication, of the report of the area.

How Soil Types are Determined.—The soil surveyor's tools are a soil auger about 3½ to 4 ft. in length capable of extension 2 or 3 ft. deeper if necessary, a spade and a hand trowel. In ordinary soil surveys, the auger is the implement most used. With this instrument, the surveyor determines the texture of the surface soil and establishes the class of the soil type under examination, together with the other various characteristics of the whole soil section to a depth of 3 ft. or more. He therefore examines the whole of the soil profile with the soil auger. The number of examinations necessary depends entirely upon the amount of detail encountered in the field, but in no case, in detailed mapping, are examinations made at a greater distance than a quarter of a mile apart. When all the soils of the selected area are identified and mapped, the report of the area is written.

The Soil Survey Report.—The soil survey report aims to give a very brief description of the area under survey, such as its location, boundaries, size, the general physiography, topography and the drainage of the region. Brief statements are made concerning the character and density of the population; principal towns; transportation facilities by rail, road or water; markets; and climate. The distribution and amount of rainfall; extremes of heat and cold; frosts; and the length of the growing and grazing season are given; and the influence of these climatic factors on the agriculture of the region is stated. Considerable information concerning the present agriculture of the area is also included, such as the history of crops and soil usage, the present status of agriculture, with particulars of the main money crops and principal subsistence crops. Census figures are quoted showing the extent, yield and value of the different crops produced and the number and value of live-stock. The adaptations of various crops to the soils of the region are mentioned, together with such facts as methods of cultivation; farm equipment used in the area; rotations practised; fertilizer treatments to pastures and the various crops; the kind, efficiency, wage and abundance of labour available; the average size of farms; and the tenure and money value of land. This information aims to furnish the reader with a clear idea of the general nature of the various agricultural conditions existing within the region.

Most of the report, however, is given to a detailed discussion of the soils, each soil type is named, its colour, depth, texture and profile described, together with a detailed description of the location, topography, drainage, agricultural importance and nature of use, *i.e.*, whether as arable land, permanent or temporary pasture or for forestry. The relative importance of crops grown on each soil type; the average and range of crop yields obtained; how the cultivation of each particular soil type is handled; the kind and amount of fertilizer used on crops; the cash value of each soil type; and such suggestions concerning the improvement of cultural practices as comparative observations may dictate—all these points are also related in detail for each individual soil type.

The completed report, therefore, furnishes a considerable fund of agricultural and soil information of great value to both practical and scientific interests, and it is the aim of this paper to attempt to point out the value of such soil surveys and to indicate how soil survey reports may be best utilized by all those interested in the various agricultural pursuits.

Value of Soil Surveys to Institutions of Research.—Soil surveys are of inestimable value to agricultural research institutions and especially to those engaged in the solution of crop production and other problems of the soil, from whom advisory information upon these subjects may be expected. Usually, in England and elsewhere, such institutions are charged with the duty of supplying this information in some specific district, such as two or three counties or a large political sub-division. In the United States, each state supports at least one, and sometimes more than one, agricultural experiment station having the same responsibility within its respective state. These institutions are, therefore, greatly interested in their own local problems of crop and soil treatment. It is also generally recognized that different soils respond differently to given crops and given treatment, and it is, therefore, very essential that the extent and identity of the soils under treatment be thoroughly understood. This information the soil survey supplies. The manifold advantage of such basis information can hardly be questioned. By such a system in experimental soil work, all experiments are located on typical soil types with the assurance that results secured are applicable to the same soil under the same climatic conditions, and that conclusions drawn are of the utmost scientific accuracy and practical value. The State Experimental Stations of the State of Iowa are so convinced of the soundness of this system that there have been established throughout the State many soil experiment fields* located upon specific representative soil

*Soil Experiment Fields and their Value. P. E. Brown, Iowa State College (*Soil Science*, Vol. XIV, No. 5, November 1922).

types as identified and classified by soil surveys. The results from these experimental fields are giving basic comparative information for each soil type, and upon such soil problems as the use of farm manure, the application of lime, the addition of phosphorus either in the form of rock phosphate or super (acid) phosphate, the use of complete commercial fertilizers and the turning under of crop residues. By such work, the experimental error due to soil variation is reduced to a minimum. The same principle applies in other lines of agricultural research in which the soil factor plays a part, and satisfactory, accurate experimental results will only be obtained by an understanding and classification of the soil types concerned. This information the soil survey supplies.

Soil Surveys and the County Organizer, Advisory Chemist and Advisory Specialist.—The task of the county organizer and advisory chemist in any agricultural community is a most difficult one, and each crop-year brings with it additional problems and responsibilities. If the fruit crop of John Smith fails to respond to a certain cultural treatment or method of disease control, or if Will Jones desires to grow a crop of sugar beets and has never before attempted the cultivation of the crop, the adviser is expected to furnish the necessary magic to bring about the desired result. Great advances in agricultural science in the past decade have enabled the adviser to give most helpful advice. In the case of the proposed sugar beet crop, he is able to tell the grower at once the name and variety of the best seed, the kind and amount of fertilizer needed, and complete information concerning the cultural practices known to be successful in the production of the crop. In fact, he has available and actually furnishes very full information upon every condition necessary for successful production except the soil and the weather. Weather conditions are, of course, beyond human control, and add just another speculative element to crop production and the interest of farming practice; but concerning the soil, how much more simple the problem would be were the adviser able to designate and, upon examination, point out on the grower's farm the soil best suited to the sugar beet crop, or, in the too frequent absence of a desirable soil type, advise against the proposed planting and suggest other crops which he knows are successfully grown on the soils in question.

With the many duties of the adviser, he is quite unable to make personal detailed soil studies, and for lack of a soil survey the necessary information would not be to hand. Once the soil survey is completed and published, however, a great fund of soil information is at once available, and, with a little study of the report and soil map, the adviser soon finds himself in a position to say to Will Jones that the best soil on his

farm for the growing of sugar beet is the "Rexton Sandy Loam"; further that there are about 40 acres available, and to obtain maximum results with this soil the crop requires about 750 pounds of commercial fertilizer to supplement the application of about 15 tons of farmyard manure. He can further advise that there are or are not other soils on the farm worthy of consideration for the production of the crop, and the programme of beet production must be regulated accordingly. Information of such a basic character cannot fail to be appreciated in any agricultural community, and it is only through the availability and utilization of soil survey reports and maps that it becomes available. The expansion of the application of such advice to the production of any crop on available soil types of a county, or even national, area is of inestimable value in the planning of present or future economic production programmes.

The Soil Survey and the Farmer.—The farmer is the ultimate consumer of all economic agricultural information, whether it concerns machinery, animals, crops or the tilling of the soil upon which all his efforts depend. He it is that all agricultural research aims, directly or indirectly, to help. To be successful, soil surveys must be of benefit to the farmer or their existence can hardly be justified, and the expenditure of public funds in obtaining them would be entirely unwarranted. How then do soil surveys benefit the farmer, and how can he utilize them to his advantage? This at first thought seems a difficult task, for, as an individual, he is already nearly overwhelmed with his many practical problems; and it is indeed difficult for him to find time and a place in his overcrowded mind for the new discoveries the science of agriculture has to offer. He does, however, realize that his whole well-being is to a large extent dependent upon the skill with which he cultivates and understands the responsiveness of his soil to his efforts. For years and, sometimes, even generations, he and his ancestors, consciously or unconsciously have been close students of the soil, and have learned by experience, just when the "clay field" should be ploughed and how the best seed bed is prepared on that "sandy piece"; that the "sandy piece" grows good sugar beet but poor wheat, while on the "clay field" the conditions are reversed. In the little sphere of his own farm, he is an expert on the utilization of his own land, but at a total loss to express himself in *soil* terms universally understood by himself and others. Here the soil survey comes to his assistance. He obtains a soil survey report of the area in which his farm is located, he refers to the soil map and perhaps with some effort locates his land; closer observation shows him that the "clay field" really isn't "clay" at all, but Sassafras Loam, and the report also

says that this soil grows excellent wheat but a poor quality of sugar beet, just as he knows it does. Reading further he finds that it also gives excellent returns with lucerne or potatoes. Immediately comes the idea—"there on my Sassafras Loam I'll put the lucerne crop I need so badly and have always been afraid to attempt." The educational work is started; *soil terms* come into use in the community; the county organizer and advisory specialist, with the use of soil survey maps and reports, are soon able to identify, name and understand the crop adaptations, cultural treatment and economic utilization of the soils of the district.

All the agricultural interests find themselves on common "soil ground" and just as heretofore they have been able to recognize, name and underst and the economic value of Jersey cows, white leghorn chickens and alsike clover, they are able by reference to soil survey value maps and reports to identify,recognize and understand the economic value and crop adaptations of soil types. Scarcely more need be said of the value of such information to the individual farmer, once it finds root in the agricultural community. It should be emphasized, however, that it is difficult for the average farmer, personally, to seek and digest soil survey reports, but the duty of conveying the soil facts lies with the county organizer, advisory specialists and other agricultural agencies who must, of course, first acquaint themselves with the use of available soil survey reports and maps.

Soil Surveys and Land Utilization.—Perhaps the broadest and most useful application of the practical value of soil survey reports finds expression in the study of the utilization of lands for agriculture or other purposes. Such studies embrace the present as well as future possibilities of the land, and thus assist in the economic utilization of land already developed and indicate its potential possibilities. All agriculture is, of course, dependent upon the land available for cultivation or other purposes, and a complete understanding of its classification and utilization is essential for success. This applies to the agriculture of an individual farm, a county and even a nation.

As an example of its application to large land areas, the State of New Jersey, U.S.A., is of interest. The boundaries of New Jersey embrace an area of approximately 7,000 square miles or 4,500,000 acres. The value of agricultural products varying from season to season is between £20,000,000 and £30,000,000. This return comes from a great variety of crops and other agricultural products. Among the crops produced (in 1925) and their approximate acreage the following deserve mention.

Less intensive crops such as maize, wheat, oats and rye occupied approximately 340,000 acres. There were about 412,000 acres of hay made up of timothy, clover and alfalfa (lucerne). Pastures took up 355,000 acres. There were over 5,000,000 fruit trees, mostly apples and peaches, nearly 2,000,000 grape vines and a total of approximately 200,000 acres of intensive crops, such as white potatoes, sweet potatoes, tomatoes, asparagus and a great variety of other market garden crops. In addition, there were about 122,000 cows and 4,000,000 chickens. Forests occupied about 2,000,000 acres. In this State, the lands are, therefore, being utilized in a most diversified manner. Further, land values are high and agriculture is becoming rapidly intensified. It is highly essential, therefore, that each soil type be utilized in the most efficient and economic manner. Fortunately, a complete detailed soil survey of the whole of New Jersey is available. This, representing, as it does, a complete inventory of the soil resources of the State, is assisting in the solution of many agricultural problems.

An analysis of the data made available by the soil surveys shows that, in New Jersey as a whole, there are 2,511,194 acres of well-drained arable soils available, 1,091,510 acres of soils needing drainage and about 717,000 acres of soils not adapted to cultivation and therefore best utilized as permanent pasture or as forest lands. Of the arable lands, it is known and well established that certain crops and crop varieties grown in the State are better adapted to certain soil types than others. For example, the field studies of the soil survey indicate that the best soil for the production of white potatoes is the Sassafras Loam, and the State possesses a total of 184,290 acres of this soil type. The acreage of potatoes produced is now only about 70,000 acres, showing that there still remains a potential acreage of about 114,000 acres available for this crop. Should economic conditions warrant the expansion of the potato acreage, therefore, the Sassafras Loam would be the soil type strongly recommended for development. The same information is available for wheat and oats, timothy and clover, maize, rye, alfalfa, sweet potatoes, orchard and small fruits, cranberries and vegetables—in other words, all the crops under cultivation within the State.

Of the lands needing drainage, it is estimated that approximately 200,000 acres of these soil types are of sufficient potential value to warrant the expense of immediate reclamation. The balance of all land of this type in the State, under present economic conditions, is best utilized either as permanent pasture or for forestry. With the study of such complete soil information, this State is putting into effect a sound policy; land utilization and agricultural development are being made

possible only through information available in the completed soil survey.

The county organizers, advisory specialists and research workers of the agricultural college and experiment station, and the farmers of New Jersey, are being educated in the application of soil surveys so that they may all be able to identify soil types by name and understand the characteristics, utilization and value of the various soils in the State and on their own farms. This phase of the work naturally takes some time, but it is progressing rapidly and, in the near future, the county organizer and farmer will discuss the value of Sassafras Loam as compared with the Shrewsbury Sandy Loam for the production of potato or any other crop, just as they now talk over the relative possibilities of Shorthorn and Jersey cattle for the farm herd. In short, the soil survey has enabled all those engaged in agriculture to express themselves in soil terms, the lack of which, hitherto, has been a serious handicap to the exchange of helpful ideas gained either by experimentation or practical experience in the cultivation of soil types.

Soil surveys already completed throughout the United States have given soil terms and soil classification a national scope: the completion of additional surveys in other countries makes for international soil understanding. Agricultural conditions of one nation constantly affect others, for present agricultural problems are world-wide: changing economic conditions constantly affect crop production: while shifting markets and increasing competition further complicate matters. As the centres of population increase, extensive methods of production give way to intensive cultivation: new irrigation projects develop and unsuccessful ones fall by the wayside: afforested areas become new arable and pasture lands; there is an over-production of agricultural products: prices fall: unprofitable marginal lands go out of production: erosion takes its toll and further depletes them: there is a world-wide depression in agriculture; farmers become bankrupt and leave the land.

All this has taken place from time immemorial: it is taking place at the present time; "What is the solution?" we all ask at the same time realizing the many complicated factors involved. The solution of all our agricultural problems is most difficult, and perhaps, sometimes seems impossible. We may, at least, be sure that the sooner the soils of individual farms, counties and nations are completely surveyed, the sooner we may hope for that world-wide prosperity of agriculture to which every conscientious tiller of the soil is entitled.—*The Journal of the Ministry of Agriculture*, Vol. XXXVII, No. 7.

Rice: Cultivation and Treatment.

By C. E. Douglas.

World Production.

Among tropical products, there is no crop so vast as rice : the geographical incidence of this cereal is probably more widespread than that of any other vegetable product, whether cereal or otherwise. There is no other food so universally employed : rice is the stable diet of nearly half the human race.

Rice yields vary from year to year and annual records of these yields are available in most of the agricultural journals of the world. The writer of these notes sees no reason, however, to modify appreciably the approximate figures collected a few years ago for his little handbook on "Rice",—which figures are reproduced here by courtesy of Sir Isaac Pitman & Sons.

The yields of husked rice credited to the principal rice-growing countries, per annum, are as follows :—

	Tons
British India	35,000,000
The Japanese Empire	10,600,000
The Netherlands East Indies	4,250,000
French Indo-China	3,500,000
Siam	2,500,000

The United States of America, The Philippine Islands, Madagascar, Egypt and Italy, each produced from 350,000 to 600,000 tons per annum, varying according to seasonal conditions.

It should be noted, however, that while the average yield of the great Eastern rice countries may keep reasonably constant, the production of the smaller rice-producing countries may vary considerably from year to year merely because rice is not their principal crop, nor is its cultivation and treatment their principal industry : in these cases the extent of its cultivation in any year is governed by other and more important considerations.

The figures for the main rice countries are, however, sufficiently impressive. When one reads of 12 million acres under rice in Burma, another 12 or 13 million in the Central Provinces of India, with perhaps 40 million acres in Bengal, Bihar and Orissa (and an area probably at least equal to the sum of all these in China), one begins to realize the vast extent to which this particular cereal is grown.

Again, comparing Oriental with Occidental production, the exportable surplus from Burma alone is equal to the total production of the

United States of America, the Philippine Islands, Egypt, Spain, Italy, Brazil and Ceylon all lumped together.

So much for the general total yield. There is, however, a notable difference in the yield per cultivated acre. While the yield of British Indian rices averages out at rather over half a ton per acre, yields in Japan, Spain and Egypt, and also in British Guiana, average out three times as high.

The writer has personally met with not specially isolated cases where the yields have been as high as three to three and a half tons per acre, and that in areas not prepared, manured or irrigated in any special way with a view to high yields.

Varieties.

Turning now to varieties, we know that there are, literally, several thousands of these : but neither the merchant nor the housewife—who, in Europe and America at least is the ultimate criterion—is concerned with such distinctions, but only with three or four types.

In certain areas, special rices are grown which never appear in the world markets, except as curiosities : they are grown for local demands and, however valuable they may be within the limits of these localities, they have no place in the world's commerce.

Take, for instance, the fine small rices of Tonkin ; the red Sabaini (so called 70 day) rice of the Fayoum, in Egypt : or the small Mattasamba rice of Ceylon : these are perfectly good as food and even no doubt highly prized by the people living in their area of production. Outside that area, however, such rices are unknown and create no demand.

Roughly speaking, the world's markets demand three standardized types which may be classified as Japanese, Patna and American. Burma rice stands almost by itself, and yet, as might be expected in a country having such vast areas under cultivation, there are some definitely different types among well over 1,000 varieties cultivated there.

It is not proposed to deal at length here with the production of any specific area, but rather to give a general review of the subject as the result of observations in different countries visited by the writer.

The three main types referred to above are quite definitely distinguishable.

1. *Japanese Type.*—This is an almost round, barley type grain which has been successfully cultivated in many lands outside Japan, notably in Spain and Egypt.

As paddy, *i.e.*, in the husk, this grain runs about 7mm. long by $3\frac{1}{2}$ mm. wide by $2\frac{1}{4}$ mm. thick : shelled, or after the husk is removed, the corresponding dimensions become, say 5 mm. by 3 mm. by 2 mm.

2. *Patna Type.*—This is a relatively long, thin cylindrical grain as far opposed as possible to the Japanese type. Siamese rice is similar in form. The average dimensions of the paddy run to 10½ to 11 mm. by 2¾ mm. by 2 mm. while the shelled rice runs about 7½ mm. by 2 to 2¼ mm. wide by 1¾ mm. thick.

3. *American Type.*—The well-known Carolina rice is chosen in this comparison because it is a recognized standard variety of distinction, commanding a high price in the world's market.

As paddy, this grain runs from 9 to 10 mm. long by 3 to 3¼ mm. wide by 2½ mm. thick : the corresponding dimensions of the shelled rice are 7 mm. by 2½ mm. by 2 mm.

Generally speaking, genuine Carolina rice fetches the highest price, running to as much as £30 a ton, and over. Genuine Patna rice comes next, at round about £26 to £27 per ton. Spanish-Japanese type rice varies in price more than the other two, but has run from £16 to £19 during 1929. Burma rice, while of admirable quality and having a food value at least equal to that of the more expensive varieties, runs from about £12 to £15 per ton.

Rice Cultivation.

Apart from Western countries where wages are much higher than in the East, and where more money, and the latest agricultural machinery are alike available, there is little difference between the methods of cultivation adopted in one Oriental country compared with another.

It is remarkable how closely individual grains of recognized standard varieties conform not only to type but as regards dimensions. An interesting comparison can be instituted by setting out diagrams indicating the length, width and thickness of the individual paddy grains. The length of the diagram is, say, six times the length of the grain, the width of the centre six times the breadth of the grain, the width at each end is six times the thickness of the grain. Even if several diagrams, based on the dimensions of a number of similar type grains, are made and superimposed on one another, such variations as may well occur in individual grains are found to be confined within narrow limits.

Three conditions are essential for growing rice : plenty of water, an impervious subsoil to prevent that water from draining away, and an adequate temperature.

A medium loam is a suitable soil in which to grow rice, provided always that it can retain water. Water there must be, whether obtained from natural rainfall over a sufficiently extended period, as in India, Siam, French Indo-China, Japan and Java ; or by irrigation only and not from rainfall, as, for example, in Egypt, and to a great extent in Italy.

The usual procedure is to plough the land thoroughly in the Spring or immediately the first rains have softened it sufficiently: it is then harrowed and levelled and probably ploughed again. A level rice field is essential: otherwise it is impossible to maintain an even depth of water over the soil.

Almost universally throughout the East ploughing is done by a pair of oxen, the plough being of the simplest possible description. Deep ploughing is not necessary for rice. The use of light American ploughs operated by motor tractors is now becoming more common, although such machinery is far beyond the dreams of the great majority of Eastern cultivators.

While a pair of oxen will plough on the average three quarters of an acre per day, a light tractor plough can easily deal with six acres in the same time.

Tractors, if employed, must have amply broad wheels; in certain districts—depending on the nature of the soil—tractors with caterpillar wheels are almost essential.

At this point, a word about manure is appropriate. Heavy cropping occurs, year after year, in British Guiana, without using manure of any description. In Egypt, apart from experimental plot work, the only manurial effect is obtained by sowing berseem or clover, among the rice as it comes to maturity. After the rice is harvested, cattle are turned on to the field to graze, and ultimately, the berseem roots together with the old rice stubble are ploughed in.

In some of the important rice areas in the United States of America soya bean is planted as a green manure: all such leguminous crops are of great value to rice.

Farmyard manure is excellent, but difficult to collect and distribute in countries where millions of acres are under rice: for the same reason, as well as on the score of expense, the application of chemical manures is strictly limited. In any case, the application of artificial manures should only be done in consultation with a soil chemist.

In Japan—as in China—a dressing compounded of green and farmyard manures and village sewage, is almost universally employed, with highly satisfactory results.

Seed Selection.

While this obviously is of primary importance it constitutes a very difficult problem in the great rice growing countries of the East, where production is in millions, and seeds must, therefore, be reckoned in tens of thousands of tons. Japan, more than any other great rice country, has more or less solved the problem by most rigorous inspection in all

the rice growing prefectures. In a highly developed agricultural country like the United States of America, seed selection becomes a relatively simple matter, the more so as the total quantity grown in the Southern States and in California combined, is only a fraction of the production of British India alone.

The smaller the area under cultivation, the more easily can the difficulty be got over. It is a trivial matter to grade and specially select one ton of seed to produce 50 or 100 tons of paddy: but how to set about the selection of the quantity of seed necessary to yield several million tons of paddy is a problem of infinitely greater magnitude. It can only be dealt with by the gradual introduction, in the most favourable areas, of seed selecting stations and seed farms, and the gradual extension of the system as and when circumstances permit.

Various mechanical methods of seed selection have been tried in different countries. Naturally, the principal object of seed selection is to get uniform grain—uniform not only as to its behaviour in the field, its time of maturity and its yield—but also as to its physical characteristic on milling, and its subsequent appearance on the market.

Paddies which grow with a long awn or beard at the end of the grain are a curse to the good miller, though the rice itself may be excellent. Rices which exhibit a red cuticle surrounding the kernel under the husk are also most annoying; they require an unnecessarily high degree of milling—often involving considerable breakage of the grain—before commercially attractive white rice can be produced.

Personally, the writer would say: "root up and burn all awned and red rice;" there are plenty of other varieties to select from.

Selection being more or less satisfactorily effected, the seed is frequently placed in bags which are well soaked in water and then covered over with mats to start germination; immediately after which it is sown, the surface of the soil having previously been well puddled.

In America, rice is sown by drills but in the East it is broadcast—at least as regards the nursery beds. As soon as the seed has taken root, water is admitted to the field and a depth of from five to six inches is maintained, if possible, during the whole period of growth.

Rice is preferably sown in nursery beds, from which after four to six weeks, it is transplanted to the main fields, which of course must also be levelled, puddled and watered to receive the seedlings. These are planted in rows some eight or nine inches apart, two or three seedlings to each hole.

Harvesting.

The life period of different rice varies considerably: in some cases it is as short as 80 or 90 days, as, for example, in the case of Sabaini rice

in Egypt ; in other cases, it may require a period of 200 or 210 days, or even more, to attain maturity. From 140 to 150 days is a fair average : generally speaking, the longer the period of growth, the better the rice. Efforts have been made to find a reliable short-dated variety suitable for conditions and countries where rainfall is deficient or irrigation supplies are difficult : but upto the present, it may be stated in general terms that even 120 days is little enough time in which to expect a sound crop.

When the grain is ripe, it is customary to run all water off the fields two or three weeks before harvesting, so as to allow the ground to dry out.

While in America reaping is done by machine, by far the bulk of the world's supply is harvested by hand, being cut with a longer or a shorter straw according to local requirements. The remaining straw is left on the land and is either trampled down by cattle or is allowed to rot and is ploughed in next season. In certain cases it is burnt.

After the grain is cut, it should be stacked or hung in the open for two or three weeks, if possible, in order to dry it out. It is dangerous to store damp grain. Thereafter, it is thrashed either by being trampled out by oxen (in which case the grain may be cut with a relatively short straw) or it is cut with a long straw, and thrashed by striking the grain over the edge of a tub, a sparred table, or even over a board set up on edge. Needless to say, all these methods are crude, slow and wasteful, but they are cheap, and they persist.

Properly designed mechanical thrashers are being increasingly employed to take the place of the older methods. These are usually most conveniently operated by crude oil, or paraffin engines. The machine may be stationary or portable, depending on local conditions : it may often be convenient to place the thrasher and engine in a barge, which can then be towed, by means of irrigation canals, to appropriate centres. Village districts may instal a machine to which the small cultivators can often conveniently enough convey their paddy in the straw. A well designed rice thrasher will clean and dress the paddy.

Where mechanical thrashers are not employed, it is essential to clear the paddy which has been trodden out by oxen. It is impossible to prevent the grain thus thrashed becoming mixed with mud, straw and animal excreta ; moreover, there is usually a certain amount of dead or immature grain ; all this waste matter would be taken out in mecha nical thrashers ; but if these are not available, the trodden-out grain should at least be passed through suitably designed grain cleaners, to remove useless material.

Milling.

We now come to the final treatment of the cleaned thrashed paddy. In India, in Ceylon, in British Guiana, and now to a considerable extent in Burma, the paddy is subjected to a preliminary process known as par-boiling. This process is carried out almost exclusively for the benefit of East Indian consumers, whether in their own or other countries.

The paddy is first steeped in warm water for a period varying from 20 to 30 hours, and, after draining, is then subjected for a period of 10 to 15 minutes, to the passage of low pressure steam. The sodden grain is then spread out on concrete floors and exposed for a day or two to the heat of the sun, which dries it uniformly. It is then ready for milling.

The advantages derived from this process are, that the grain is shelled with the greatest possible ease : that being greatly toughened by the process, it can be subjected to severe milling without too great loss from breakage : that it keeps better : and that it is undoubtedly more nourishing than the white rice of European and Western commerce.

It is freely eaten and appreciated by Europeans living in the areas where it is prepared, while yellow or pale coffee colour when milled, it turns practically white on cooking.

Rosetta, in Egypt, has a method of rice preparation entirely its own. There the paddy is pounded in large mechanically operated mortars with an admixture of salt rock and gypsum. The resultant rice finds a ready market in the Levant but the writer has never come across a similar method of treatment outside Rosetta.

As far as the pounding is concerned, this is a more or less modern development of the crude method of milling adopted by most native races throughout the world. The mortar may be a hollow scooped out of the hard earth, or it may be a hole cut in the stump of a tree ; the pestle may be a bamboo shod with an iron band and raised and lowered by hand, or it may be a ram of hard wood attached to one end of a pivoted wooden beam, the other end of which is depressed and released by foot. The principle is the same ; the process is slow, but the results are not too bad.

The primitive miller then scoops out the contents of his mortar and probably tosses them in the air to give the wind a chance of winnowing away the husk and light bits of broken grain. The balance is his rice of commerce.

Where the paddy has been previously toughened by par-boiling, or where its form and character is robust enough to stand the treatment, this machine does wonderfully good work. It requires, however, considerable power in relation to its output ; it destroys the husk, and

provides no means for the separation and recovery of the valuable bran (from the cuticle of the rice) or of the broken grain.

In small native mills treating four or five tons of paddy per day and producing par-boiled rice, or a second or third quality white rice, this machine has a definite place. Where it is a question of treating high grade white (unboiled) rice in considerable quantities, other methods are adopted.

It is perhaps difficult for the layman to appreciate that, in Burma, French Indo-China and Siam, there are probably hundreds of mills each treating several tons of paddy per day. One hundred tons of paddy will produce approximately 65 tons of rice. There are mills in Burma and in Indo-China capable of milling anywhere from 1,000 *to* 1,500 *tons of paddy* per mill per day.

In these modern mills, paddy-cleaning machines, of one design or another, are always installed because the miller can never be sure that all, or indeed any, of his incoming grain has been cleaned.

The clean paddy is then passed to the shellers, which consist of an upper fixed disc and a lower one rotating at high speed. Both discs are coated with a special mixture of emery and cement and the paddy is introduced through a central hole in the upper fixed disc. The distance between the emery faces and the discs can be adjusted—even while the machine is working—to suit the character of the grain.

The product of this machine is shelled grain mixed with a proportion of smaller still unshelled grain, and husk.

All this is passed through a winnowing or aspirating machine to remove the husk which is collected and used as fuel. All the mills in Burma, Siam and Indo-China are driven by steam engines and the only fuel used is the husk obtained from the paddy.

The shelled and unshelled rice are then passed to a special separator which divides the shelled from the unshelled grain. The latter is returned to the shellers, while the shelled grain is passed on to be whitened.

The shelled grain at this point is often termed "Loonzain", it is also shipped as "Cargo Rice", containing say from two per cent to five per cent of paddy and ten per cent of broken rice. As the husk is 20 per cent of the weight of the full paddy grains this weight is saved in shipment and the husk is retained as fuel. The brown, or Cargo rice (or ' Loonzain") is then often shipped to Europe and to America and Canada to be milled up to the required degree of finished white rice.

Whitening consists of removing the cuticle (which lies beneath the husk and surrounds the kernel) by attrition between a rapidly revolving iron cone—again covered with a mixture of emery and cement

and a stationary wirecloth casing. The cuticle is rubbed off the kernel and passes through the meshes of the wirecloth as meal or bran. It is a most valuable cattle food as it contains from 16 per cent to 18 per cent of oil.

The now whitened rice may be, and often is, passed through yet another cone machine, coated perhaps with finer emery and surrounded possibly by a lighter wirecloth. Thus the whitening process is continued ; by using several cones in series, each lightly milling only a small percentage off the surface of the grain, a high degree of finish can be attained with a minimum of broken rice.

It is incorrect to speak of this rice as polished ; it is only pearled or whitened, and it is not necessary to carry the process further. Modern markets, however, demand something even more attractive ; when this is the case, the whitened rice is passed through polishers, consisting of wooden drums covered with sheepskin (wool exposed), the rice being rubbed by the soft skins against still finer wirecloth.

The surface of the grain is now white and smooth, but still further refinements are often adopted. The rice may be lightly steamed and oiled to give it a transparent appearance, or it may be revolved in a drum along with a previously prepared mixture of talc and glucose, which together impart an artificial glaze to the grains. This is known as glazed or coated rice, which has no merit beyond an attractive appearance. Incidentally, all the polish and glaze disappear when the rice goes into the cooking pot.

There are, of course, intermediate stages and auxiliary machinery for separating out broken rice, which, in large mills, it often carried to an accurate degree of classification. Graded broken white rice usually commands a good market ; it is used for conversion into high class laundry starch, into alcohol, for brewing, for making rice flour, and when finely crushed, for making face powder and pharmaceutical preparations.

In short, there is very little of the original grain lost in a modern mill. Husk, broken rough rice, bran or meal, whole rice, and broken white rice are all recovered and bagged off for their particular use or market.

Accurate records are kept of input and outputs, and by this means it is possible to control, easily and intelligently, the most economical operation of a mill to suit varying market conditions.

This, briefly, is the condensed story of the cultivation and treatment of rice from start to finish.—*The Journal of the Imperial College of Tropical Agriculture*, Vol. VII, No. 7.

Prohibition of Import of Unroasted Coffee Beans.

The attention of the public is drawn to the following notification of the Government of India, Department of Education, Health and Lands, dated, Simla, 21st June 1930:—

NOTIFICATION.

In exercise of the powers conferred by sub-section (1) of section 3 of the Destructive Insects and Pests Act, 1914 (II of 1914), the Governor-General in Council is pleased to prohibit with effect from the 8th August 1930 the import of unroasted coffee beans into the Madras Presidency by sea or, save where the import is from a place within India, by land.

Provided that the prohibition hereinbefore contained shall not apply to a consignment of unroasted coffee beans produced in India and covered by a certificate of origin in the form set forth in Schedule A signed by one of the authorities specified in Schedule B.

(Sd.) F. Noyce,
Secretary to Government of India.

SCHEDULE A.

Certificate of origin for Indian Coffee Beans.

Name of consignor	Name of consignee	Gross Weight	Number of Packages	Mark of each Package	Name of District in which produced

Certified that the above consignment of raw coffee beans is Indian produce grown in the district described above.

Signature of certifying authority.
Signature of consignor.

SCHEDULE B.

Certifying authority:—

(1) The Deputy Director of Agriculture, Chikmagalur, Kadur District, Mysore State.

(2) The Director of Agriculture, Madras Presidency.

(3) Any other Officer whom the Government of Madras may appoint in this behalf by notification in the *Fort St. George Gazette*.

Consignors of Mysore raw coffee beans are therefore required to obtain a certificate of origin from the Deputy Director of Agriculture, Chikmagalur, Kadur District, as prescribed in the above notification.

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